NOVEMBER 1944

# The WELDING Journal

The Journal of the American Welding Society

## SPOT YOUR BUYING POINT!

### NEW ENGLAND
BOSTON, MASS.
H. Boker & Co., Inc.

### MIDDLE ATLANTIC
BUFFALO, N. Y.
Root, Neal & Co.
ERIE, PA.
Boyd Welding Co.
NEW YORK CITY
H. Boker & Co., Inc.
PHILADELPHIA, PA.
Arcos Corporation
PITTSBURGH, PA.
Williams & Co., Inc.
ROCHESTER, N. Y.
Welding Supply Co.
SYRACUSE, N. Y.
Welding Supply Co.

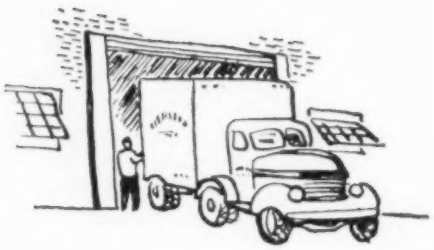
### SOUTH and SOUTHWEST
BATON ROUGE, LA.
Wm. D. Seymour Co.
BORGER, TEXAS
Hart Industrial Supply Co.
HOUSTON, TEXAS
Champion Rivet Co. of Texas
KINGSPORT, TENN.
Slip-Not Belting Corp.
PAMPA, TEXAS
Hart Industrial Supply Co.
OKLAHOMA CITY, OKLA.
Hart Industrial Supply Co.
TULSA, OKLA.
Hart Industrial Supply Co.
NEW ORLEANS, LA.
Wm. D. Seymour Co.

### MIDDLE WEST
CHICAGO, ILL.
Machinery & Welder Corp.
CINCINNATI, OHIO
Williams & Co., Inc.
CLEVELAND, OHIO
Williams & Co., Inc.
COLUMBUS, OHIO
Williams & Co., Inc.
DETROIT, MICH.
C. E. Philips & Co., Inc.
FORT WAYNE, IND.
Wayne Welding Sup. Co., Inc.
KANSAS CITY, MO.
Welders Supply & Repair Co.
MOLINE, ILL.
Machinery & Welder Corp.
MILWAUKEE, WIS.
Machinery & Welder Corp.
ST. LOUIS, MO.
Machinery & Welder Corp.
WICHITA, KANSAS
Watkins, Inc.

### WEST COAST
FRESNO, CALIF.
Victor Equipment Co.
LOS ANGELES, CALIF.
Victor Equipment Co.
PORTLAND, OREGON
J. E. Haseltine & Co.
SAN DIEGO, CALIF.
Victor Equipment Co.
SAN FRANCISCO, CALIF.
Victor Equipment Co.
SEATTLE, WASH.
J. E. Haseltine & Co.

### CANADA
MONTREAL, CANADA
G. D. Peters & Co. of Canada Ltd.

### HAWAII
HONOLULU, HAWAII
Hawaiian Gas Products, Ltd.



# AN ARCOS WAREHOUSE STOCK IN YOUR CITY...
## *or close at hand...*

★Chrome-Nickel Stainless Electrodes
Straight Chrome Stainless Electrodes
Chrome-Moly Steel Electrodes
Manganese-Moly Steel Electrodes
Non-Ferrous (Bronze, Nickel, etc.) Electrodes

★Available for DC or AC Welding

**ARCOS CORPORATION**
401 NORTH BROAD ST., PHILADELPHIA 8, PA.

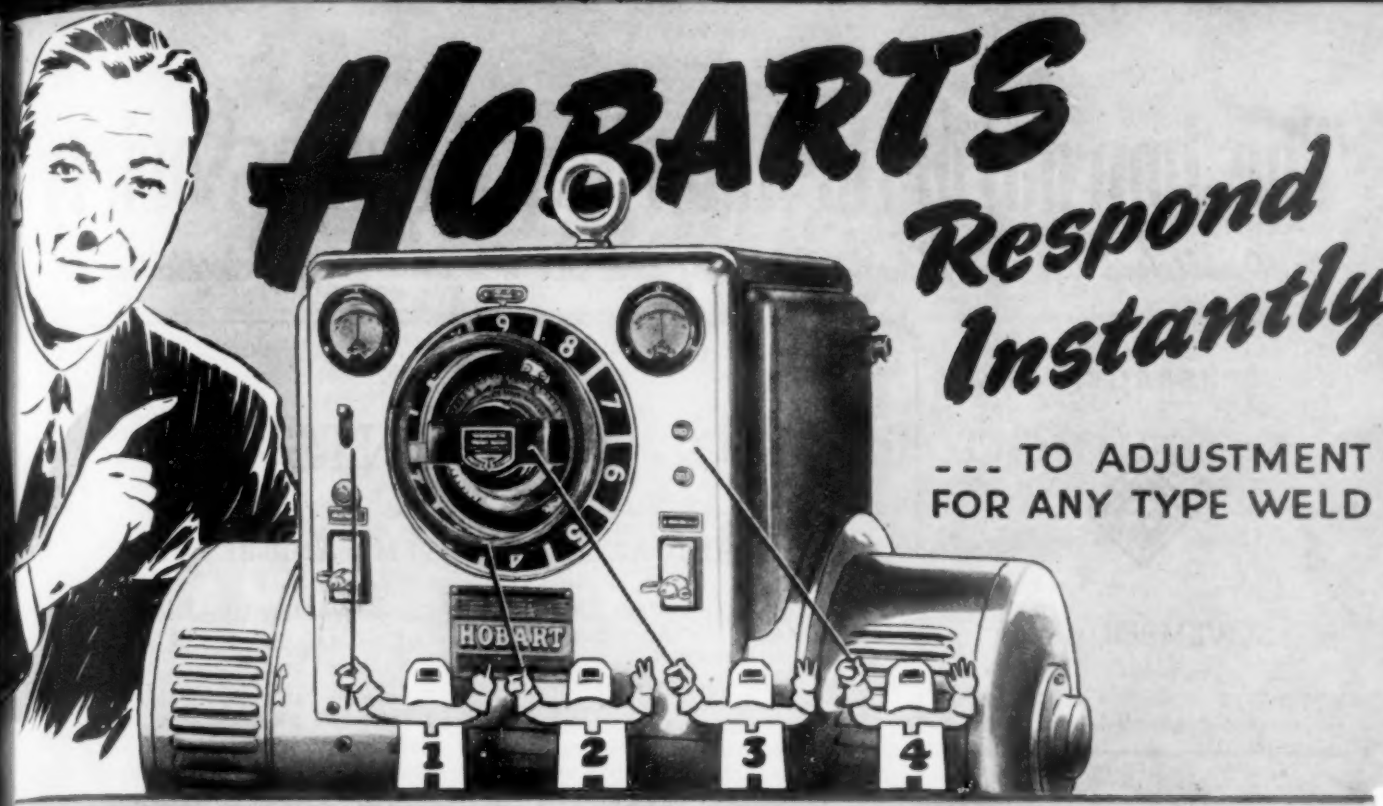
ARMY E NAVY

*it's* **ARCOS** *for stainless electrodes*

"QUALITY WELD METAL EASILY DEPOSITED"

# HOBARTS Respond Instantly

## ... TO ADJUSTMENT FOR ANY TYPE WELD




"PRACTICALLY AUTOMATIC," is what welders everywhere are saying about the Hobart Multi-Range Dual Control Arc Welder. Of course they know an automatic arc welding generator is out of the question for the present. However, they find Hobart the nearest thing to automatic on the market today. Figures above indicate the features that are responsible for the fine, close control you get with a Hobart. (**1**) Convenient and simple switch for changing polarity to suit the different types of electrodes. (**2**) Outer wheel and dial for selecting the desired welding range. It provides 10 steps which, with the 100 steps in the inner wheel, make possible a wide range of 1,000 volt-ampere combinations. (**3**) Inner wheel and dial for adjustment of heat and of relation between voltage and current. Removable for Remote Control. (**4**) Starting switch located inside turret top. Start, stop and reset buttons on outside of cabinet. Switch fully protected against overload, under-voltage and conditions of phase unbalance in power supply.

**HOBART BROS. CO. Box WJ-114, TROY, O.**

*One of the World's Largest Builders of Arc Welding Equipment*

## Get this new HOBART ARC WELDING DESIGN SERVICE

**Issued Semi-Monthly - Worth Hundreds of Dollars To You**

Initial editions are FREE, if you're interested in re-designing your product for Arc Welding, and will tell us on your letterhead about your plans and present equipment.

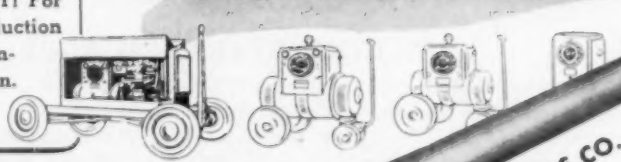
***Initial pages FREE . . . but you can get a Complete Set in book form, over a hundred pages for ONLY $3.50 Postpaid***

This, and subsequent volumes will be the MOST VALUABLE BOOKS IN YOUR LIBRARY! For Designers, Engineers, Production Management, or anyone interested in metal fabrication. Send for yours today!

## FREE! *Vest Pocket Guide for Welders*

Handy information that all welders will use daily. Tables, charts, etc.

# HOBART "Simplified" ARC WELDERS



HOBART BROTHERS CO., BOX WJ-114, TROY, OHIO

- ☐ Check here for catalog showing the Hobart line.
- ☐ Please send me information on items checked, without obligation.
- ☐ Gas Drive Welder
- ☐ Electric Drive Welder
- ☐ "Practical Design" Sheets
- ☐ Vest Pocket Welders' Guide

NAME _____

POSITION _____

CITY _____ STATE _____

**BUY MORE BONDS for VICTORY**

# The Journal of the American Welding Society

*Published for the Advancement of the Science and Art of Welding*

W. SPRARAGEN, Editor

NOVEMBER, 1944

VOLUME 23 NUMBER 11

OFFICERS—1944-1945

President, A. C. WEIGEL
First Vice-President, ISAAC HARTER
Second Vice-President, WENDELL F. HESS
Treasurer, O. B. J. FRASER
Secretary, M. M. KELLY
Technical Secretary, L. M. DALCHER
On Leave of Absence
Acting Technical Secretary, SIMON A. GREENBERG
District Vice-Presidents
District #1 (New York & New England)—F. C. FYKE
District #2 (Mid-Eastern)—H. W. LAWSON
District #3 (Southern)—F. E. McATEE
District #4 (Central)—J. F. MAINE
District #5 (Mid-Western)—W. J. BROOKING
District #6 (Mid-Southern)—M. A. BARRETT
District #7 (Western)—F. A. LONGO

COVER

Flash-Welding Special Steel Parts at the *General Electric Company*

ISSUED MONTHLY

Copyright 1944, by
The American Welding Society

Subscription $5.00 per year in United States and possessions; Foreign Countries $7.00. Single copies, non-members $.75; Special issues October and December $1.00; members 50 cents

Entered as second-class matter January 15, 1932, at the post-office at Easton, Pa., under the act of March 3, 1879.

PUBLICATION OFFICE
20th & Northampton Streets, Easton, Pa.

EDITORIAL AND GENERAL OFFICES
33 West 39th St., New York 18, N. Y.

The Society is not responsible for any statement made or opinion expressed in its publications. Permission is given to reprint any article after its date of publication provided proper credit is given.

# CONTENTS

## TECHNICAL PAPERS, ITEMS AND REPORTS

Welding as an Aid in Shipbuilding Construction, by Rear Admiral Howard L. Vickery, USN ... 1011
Locomotive Engine Truck Casting Restored to Service by Welding, by R. C. Hempstead ... 1014
Proposed Recommended Practices for Resistance Welding—4. Standard Methods for Mechanical Testing of Resistance Welds ... 1015
Current Welding Literature ... 1019
Metallic Arc Welding Electrodes, by Harold Lawrence ... 1020
Fabrication and Reclamation in Steel Mill Maintenance, by E. W. Gruber ... 1031
The Welding and Heat Treating of Couplers and Other Car Parts, by John McMullen ... 1041

## SOCIETY AND RELATED ACTIVITIES

American Welding Society Receives Ordnance Distinguished Service Award ... 1048
The 25th Anniversary Annual Meeting of the American Welding Society ... 1048
Convention Workers Honored ... 1048
Solid Phase Welding Described at Welding Society Annual Meeting 1050
Prize Winners ... 1050
Index to Advertisers ... 1050
Miller Medal Awarded to F. T. Llewellyn ... 1054
Sections Honor Miss Kelly ... 1056
A.S.M.E. Receives Distinguished Service Award ... 1056
A.S.T.M. Receives Ordnance Distinguished Service Award ... 1056
A.F.A. Board Elects Staff Officers ... 1058
New Welding Film ... 1058
A.S.A. Ordnance Award ... 1060
Positioning Equipment ... 1060
Drop Forgings ... 1060
Welded Seaplane Mooring Bit ... 1060
Shot Peening and the Fatigue of Metals ... 1060
Important New Actions on Standards by the A.S.T.M. ... 1060
A.S.T.M. Advances by Full Year Publication of Its Book of Standards ... 1064
Chemical Analysis of Metals ... 1064
American War Standard Specifications for Protective Occupational (Safety) Clothing ... 1064
New Hard-Facing Pamphlet ... 1064
Winners in $4750 Postwar Planning Contest ... 1066
Resistance Welder Improvements ... 1066
O. C. Tabbert Made Assistant Manager ... 1066
Welded Piping Fittings ... 1066
Three-Day Meeting on Stress-Corrosion Cracking ... 1066
Osha Promoted ... 1070
Flash Welding Twist Drill ... 1070
Platz Joins Sciaky ... 1070
Flash Welded Cold-Rolled Steel Rod 1070
The Effect of Moisture in Welding Electrode Coverings of the A.W.S. E6010 Type ... 1072
Spiral Stairs Welded to Pipe ... 1074
Tool Steel Welding Manual ... 1074
New Products ... 1076
Employment Service Bulletin ... 1082
Sustaining Companies ... 1082
Sustaining Member ... 1084
List of New Members ... 1084
Members Reclassified ... 1088
Section Activities ... 1090
Annual Report on Activities of the American Welding Society ... 1095

## WELDING RESEARCH SUPPLEMENT

Shrinkage Distortion in Welding, Review of Literature, by W. Spraragen and M. A. Cordovi .. 545-s
Radiography for Development and Control of Aluminum Alloy Spot Welding, by G. W. Scott, Jr., L. G. Sutton and J. H. Widmyer 560-s
Bibliography of Stress Analysis by Means of X-Ray Back-Reflection Method, by H. R. Isenburger .. 571-s
Researches in Alloy Steel Welding, by D. Hanson, A. H. Cottrell, K. Winterton, J. A. Wheeler and P. D. Crowther ... 573-s

**The Journal of**
**The American Welding Society**
VOLUME 23 • NUMBER 11 • NOVEMBER, 1944

# Welding as an Aid in Shipbuilding Construction*

By Rear Admiral Howard L. Vickery, U.S.N.†

ANY remarks which I may make at this time on the aid that welding has been in ship construction are necessarily confined to merchant shipbuilding. I have no doubt but that welding has been of even more advantage to naval construction owing to the large number of small all-welded craft which have been built for military use.

In appraising the various factors which have played an important role in enabling the merchant shipyards of this country to hang up their marvelous production record, it is believed that welding as the "tool of construction" would rank well up near the top. In fact the entire emergency shipbuilding program has been founded on the essentially all-welded ship.

The success of the emergency ship construction effort may be judged from several angles such as:

1. The delivery of adequate tonnage when most needed.
2. Usefulness of the vessels.
3. Ability of the vessels to stand up to wartime service.
4. Cost to the taxpayer, etc.

I do not hesitate to say that in every one of these, the emergency ships have proved a distinct success. The part which welding has played in this success is commented on in more detail as we go along.

The extent of the use of welding on Maritime Commission long-range ships has been progressively greater as the advantages become more apparent. In the first of the C2 designs laid down in 1937, the shell, innerbottom and shelter deck plating were required to be riveted. Elsewhere, welding was permitted at the discretion of builder subject, of course to approval by the American Bureau of Shipping and the Commission. Later specifications in 1940 required the bulkheads forming the deep tanks to be welded, elsewhere the extent of welding was at the option of the builder subject to the usual approvals. Still later, specifications left the extent of welding entirely up to the shipbuilder.

The early long-range type vessels were, of course, constructed in the old-line yards, which were in the main equipped for riveting. However, as weight saving and rapidity of construction made possible through the use of welding became apparent, it was resorted to more and more. This led to new yards which came into being prior to the emergency shipbuilding programs being initiated, to be laid out for the use of welding entirely.

Thus, when the World War conditions indicated that emergency construction must be resorted to by this country, there was a considerable background of knowledge and achievement in the production of welded ships. It was realized by the Commission that new shipyards would have to be built in which to construct these emergency ships. Logically these shipyards should be laid out to incorporate all the desirable features developed in the construction of the long-range ships. Resort to the full use of welding followed and the design of ship selected and the layout of the shipyards were made on that premise.

This decision to exploit in full the potentialities of welding in respect to mass production of ships has proved to be a sound one. The tonnage produced by American shipyards has far exceeded the most optimistic of initial expectations and has surpassed many fold, as you all know, all previous shipbuilding records. In fact many of us still look at the production record and say with a full understanding of the Irishman's bewilderment when he first saw a camel, "There ain't no such animal." Many believe without fear of successful contradiction that without this stupendous output of ships the enemy's calculations for a subjugated world would have been more than the idle dreams they are today.

At the outset of the emergency program the ships were scheduled on the basis of 180 days from keel laying to delivery. When Pearl Harbor brought us into the war, an immediate tremendous expansion of the program became imperative. New shipyards were started and scheduling of construction was stepped up to 105 days between keel laying and delivery. How this schedule was met in August 1942 and later far surpassed is common knowledge. The best average was made in December 1943 when 118 Liberty ships were delivered under 40 days after keel laying and about 28 days keel to launching.

We must not lose sight, however, that, without the shipbuilding know-how of the shipbuilders and full adherence to standardization, central purchasing, and team work from labor, management and manufacturers all over the country, the fine achievements could not have been possible. The introduction of mass production methods used in other fields by newcomers in the marine field into the building of ships was also a big factor.

* Presented at the Twenty-Fifth Annual Meeting, A.W.S., Cleveland, Ohio, Oct. 16 to 19, 1944.
† Vice-Chairman, U. S. Maritime Commission, and Deputy Administrator, War Shipping Administration.

The welding of ships, especially of tankers, has a considerable background of experience outside of that gained in constructing the long-range ships prior to the present emergency period. This gave additional valuable data which were used to advantage in equipping the yards and setting up sequences of welding and erection. However, completely welded large ships were relatively few and their service was of too short a duration to give adequate information on their behavior. No indication was given that an all-welded hull behaved sufficiently different when subjected to heavy service at sea than a riveted hull, and therefore must be most carefully designed and erected in the shipyard. The Maritime Commission long-range types of vessels have, in general, the interior structure and weather deck welded and the shell seams riveted. There was some variation in the amount of welding employed between the yards engaged in the building of these ships. In two yards the vessels were completely welded. All these long-range vessels have made enviable records in most severe service.

An indirect and important advantage which has accrued from the use of welding is the saving in the amount of steel by proper design. This was most apparent during the critical periods when steel production scarcely met the demands of the war effort. The resultant increase in dead-weight carrying capacity of the ships is also important. This saving of weight has apparently been most pronounced in the lower portions of ships, with a resulting adverse effect on stability due to the center of gravity of the light ship rising. This phenomenon has required a consequent addition to the width of a welded ship over that of the conventional riveted type to make up for this loss of stability.

The decision having been made to utilize welding in building the emergency vessels, some changes had to be made in the design selected in order to facilitate the use of welding. As you no doubt know, the Liberty ship is based on the British "North Sand" type ships. Some latitude was allowed the yards in respect to the welding of the shell. This led to some yards riveting the shell to the frames while welding the seams and butts, while others used welding exclusively. One yard welded the frames to the shell but riveted the seams and welded the butts. The service records of these ships indicate that all types of construction resulted in sound ships.

The new shipyards which were built to handle the emergency program were laid out to utilize to the fullest the mass production principles to which welding is peculiarly suited. Considerable space was provided for preassembly platens, and for storage of assemblies until needed on the ways. The lifting facilities were of as large capacity as could be obtained. This made possible the use of large subassemblies, thus cutting down the number needed and on the assembly and welding work needed to be done on the ways. The preassemblies in many instances included piping, fittings, foundations, electric wiring, etc.

Welding has, no doubt, increased the speed of merchant shipbuilding immeasurably for a number of reasons. Some of these reasons are inherent in welding itself. Other reasons are more or less independent of welding. Among the latter class, as mentioned before, is the full utilization of mass production methods by the preassembling of all possible structure and using the shipway as the final assembly point. This enabled the maximum number of workers to be productively engaged in assembly and erection work, and obtaining the maximum output for the number of building ways, balancing this with the flow of material into the yard. This assembly line method was made possible by laying out the yards with ample assembly platens, storage space and heavy lift crane facilities to handle the prefabricated sections. The extent to which proper preassembly can increase the speed of ship construction has been spectacularly illustrated by the assembly of a ship and its launching within four days. It is considered impracticable, however, to provide sufficient facilities or to obtain the backlogs of materials which would be necessary for regular construction in any one shipyard at that rate.

The full application of the assembly line method has never been applied to riveted ship construction. The World War I famous shipyard at Hog Island was the best example, of assembly line methods as applied to riveted ships. It is noted however, that in 1919 this yard turned out 69 riveted vessels of 517,500 tons on fifty ways, while one of our 12-way yards turned out 205 welded ships of 2,152,500 tons dead weight in 1943. It may also be of interest, that in spite of an average higher pay scale in the shipyards today, over World War I, the cost today is $160 per dead-weight ton as against $210 for the last war. It is not believed, however, that the production program could have been met on time even if full application of the assembly line method could have been used in building riveted ships. It may be noted here that in one shipyard, the fact that the shell seams were riveted was given as the reason why the hulls were on the ways a longer period than in yards where the shell was completely welded. The use of welding on the shell permitted the preassembly of the plating and frames into panels, whereas in riveting the plates are fitted and erected individually.

The use of welding made it easier to equip the shipyards as it reduced the number of heavy shop machines required, such as punches, shears and planers. Also, there was less need for air compressors, air hose and pneumatic tools, which in the total war effort lightened the load on the heavy tool-making industry. Flame-cutting torches were largely substituted for plate shears and planers for preparing plate edges for welding. Of course thousands of welding machines were used, but these were far outweighed by the savings in other equipment.

The number of operations required to fabricate the plates and shapes was greatly reduced from that required in riveted construction. This also holds true in respect to the number of operations required in assembling the various plates and shapes. All this resulted in a much higher percentage of workers being directly engaged in actual assembly work on the platens and on the ways, resulting in an over-all saving of man power and man-hours per ship.

The welding operation inherently has a direct bearing on production speed in a number of ways. It permits a subassembly to be made into a finished unit capable of being handled into storage, then to the ship without impairing its structural integrity. Thus many men can be engaged at one time in making up the large subassemblies on the various assembly platens. The amount of welding and fitting needed on the ways is consequently cut down, which adds up to a reduced time between keel laying and delivery. The ability to crowd a large number of man-hours into a short time, as measured by the calendar, made possible by the use of welding, really is the big factor in rapid construction. In riveted construction much laborious work has to be done on the ways, such as laying up of flanges, caulking seams and rivets, etc., to make a tight ship, so that it is not possible, due to space restriction in a hull, to crowd the man-hours in to the extent possible in welding.

One of the most difficult of the many problems which the extremely rapid expansion of the shipbuilding programs brought into being was that of training and keeping shipyard personnel, especially welding operators and supervisors. As you no doubt are aware, an all-round

good welder cannot be trained in any very short space of time even though some have stated to the contrary from time to time. However, as in many other shipyard crafts, welding is adaptable to the use of the so-called "special phase" training system, whereby the trainee is taught to perform a particular job quickly and then is put on simple production work. Due to the high turnover in shipyard welders and the inroads of the draft, it has been extremely difficult to raise the quality of welding to the standards desired. However, considerable progress has been made and efforts along that line are continuing.

The welding operator after initial training in a school operated outside of the shipyard, or by the shipyard itself, is required to demonstrate his ability to do down-hand welding by making samples which are tested. It is then possible to use such a trainee on production work on tacking or flat-position welding under close supervision. As his skill increases he is taught successively to make welds in the vertical and overhead positions and required to pass qualifying tests to demonstrate his ability to make sound welds. The production load being very heavy, and labor turnover large, it has been extremely difficult to obtain and hold a sufficient number of fully qualified welders capable of doing the more difficult and important welding. Also, the supervisory force was recruited mostly from those welders who were fully qualified for all-position welding which still further complicated the problem. Training programs are being intensified and every effort made to impress on both the welding supervisors and operators the necessity for making good welds and adhering to established sequences.

By adequate planning of the work, it is possible to do a large percentage of the welding in the down-hand position, and thus utilize the numerous less skilled welding operators. This is particularly true in the assembly platens and in the shops, and was a very large factor in attaining the high production records which the shipyards have hung up. Also the assemblies and erection procedures are planned so that as much welding as possible on the ways is in the down-hand position. A sufficiently large number of all-position welders are needed in each yard to insure that the important construction joints on the upper portion of the vessel are welded by men with experience and skill.

The need for the establishment of proper welding sequences and strict adherence to them is generally accepted by most well informed persons in the welding field. With the pressure on for quick delivery of ships, especially during the early part of the emergency building program, some deviations from these sequences no doubt were made to increase production. With proper planning and the will to stick to the plans which are made, there is no sound reason apparent to me why good production and proper welding procedure cannot go hand in hand.

The advantages of welding in keeping ships in operation with the minimum of lost time in the repair yards have been demonstrated time and again. Many welded vessels which have received torpedo hits, or suffered collision or grounding have been repaired in a fraction of the time and cost a riveted hull would have required. Also, in many instances the damage has been definitely limited by the fact of the welded hull, as there were no riveted seams in shell or bulkheads to spring leaks and thus imperil adjacent undamaged holds. Under such severe conditions, in almost every instance, the welded seams and butts did not tear or crack open, and on some occasions can be said to have actually made the saving of the ship possible.

There has been much publicity given to the relatively few instances of serious fractures occurring on our ships. The causes of these fractures are not fully known, but it is generally agreed that no one factor is the predominant reason. We still have a lot to learn about stress distributions and behavior of an all-welded ship's hull under service conditions. It is of interest to note that the small all-welded ships have been practically free from serious failures. This is probably due to the relatively light plates used and to less beam action of the hull due to waves. Every effort is being made to add to our knowledge by experimentation and study, by the various governmental and private groups interested in the subject. This SOCIETY has been the leader in welding research for many years and has contributed much that is valuable.

Research, especially in respect to fundamentals, is necessarily time consuming. When the Commission was confronted with a number of serious fractures on Liberty ships last winter it was imperative that something be done immediately to ameliorate the condition. It was not possible to wait on the results of the various experimental programs which might or might not come up with an answer.

Records indicated that most of the serious fractures had started around hatches Nos. 2, 3 and 4, especially No. 3 hatch. In the summer of 1943 instructions were issued to round the corners of these hatches on both existing vessels and those under construction. It is felt that this step will greatly diminish the chances of cracks starting around the hatches due to the resultant better stress flow. Also on new ships the insert type of deck plating at the hatch corners is being avoided, as experience has shown that it is extremely difficult to properly weld such structure.

Cracks around hatch corners on riveted ships are quite common, and generally never spread to more than the first riveted seam. However, in welded ships such cracks have in some instances propagated rapidly into a complete failure of the deck and upper portions of the side shell. To prevent the recurrence of such failures, orders were given to substitute double riveted gunwale angles port and starboard sides on the upper deck for the continuous welded connection. It was felt that this would prevent a crack which started in either the deck or sheer strake from progressing into the other. Also it was felt this riveted joint would introduce a degree of flexibility in an otherwise rigidly welded hull. Later a crack arrester slot on the upper deck of these vessels was installed extending fore and aft to cover approximately from hatches Nos. 2 to 4, inclusive. The coming winter will determine to what extent the measures taken will prevent serious fractures from occurring.

Many other steps have been taken to make better welded ships, and the efforts are continuing. The danger of so-called "notches" is appreciated whether they are due to workmanship or to design details. We know that the careful working out of welding procedures and the adherence to them are necessary in order to produce sound hulls.

There are many things we do not know about the behavior in service of a large welded hull such as the effect of residual stresses on stress distributions; what effect does the rigidity of the hull have; what causes the rapid propagation of cracks and what is the basic remedy; does residual stress work out of a ship in service; can a ship be stress relieved before going into service, and would the benefits of stress relieving be worth while, etc. Pending the answer to these problems and many others it was only common sense that the steps were taken to try and prevent recurrence of serious fractures. Welding of large ships is here to stay and the perfection of the art will be the aim of all interested in the marine field and in welding generally.

This paper has in very brief and general terms pre-

sented the relation of welding to the construction of merchant ships today. It has not touched upon the many years of pioneering and research in the art of welding preceding this construction and in which the AMERICAN WELDING SOCIETY has taken such a prominent part. Nor how this Society, through its Annual and Sectional meetings, has provided a common meeting ground for the exchange of opinions and results of experience and study.

I think it can be said without reservation that the AMERICAN WELDING SOCIETY, more than any other technical society, has been responsible for promoting and improving the art of welding in so far as the marine industry is concerned.

The Committees of the Society have developed a common language and designating symbols, proposed controlling techniques, qualifications and testing procedures and standards which have been generally accepted by various code authorities, and have been incorporated into the rules which govern marine welding today.

I congratulate the AMERICAN WELDING SOCIETY on the completion of twenty-five years of active and useful service and feel confident that it will continue its leadership in the welding field in the years to come.

---

# Locomotive Engine Truck Casting Restored to Service by Welding

By R. C. Hempstead*

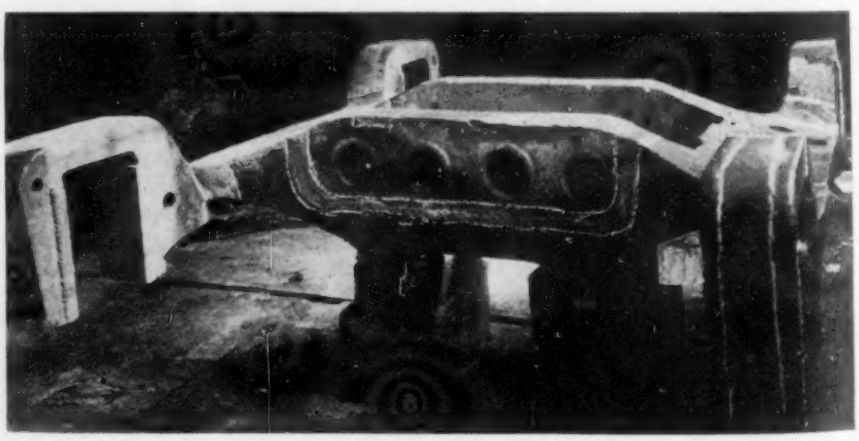
THE leading truck bed of one of our modern locomotives was badly damaged, or what would normally be considered totally demolished, in an accident. This truck bed was restored to service by employing arc welding and oxyacetylene flame processes to avoid a delay of at least eight months which would have been necessary to obtain a new casting. The repairs involved straightening of distorted areas by oxyacetylene flame heating, gouging and welding broken pieces of casting, and building whole sections made of flame-cut and welded plate to replace sections lost in the accident.

1Fig. —Three Pedestals and Part of the Body of This Locomotive Truck Casting Were Broken Off in an Accident. Some Parts Were Missing Altogether and Were Fabricated

Figure 1 shows the broken casting with three pedestals and parts of the main structure missing, preparatory to straightening. Two multi-flame heating torches were used for straightening, consuming about 900 cu. ft. each of oxygen and acetylene. After straightening, flame gouging torches were employed to gouge out grooves and vees on the broken edges in preparation for welding.

At the same time, replacement sections were being fabricated by welding for attachment to the casting. These parts were cut from rolled steel plate of appropriate thicknesses, and shaped by an Airco Planograph cutting machine to fit the broken edges of the casting. After welding of the cut parts, the fabricated portions were then welded to the main casting, completing the reconstruction job.

The repaired truck casting is shown in Fig. 2, in which chalk lines indicate where some of the welds were made. While a material saving in excess of $900 was realized, the important factor involved was the restoration of the locomotive to service in a period of three weeks as compared to eight or ten months required to obtain a new casting—it is impossible to calculate the over-all savings. The reconstructed truck has been in service approximately 120,000 miles to date and is functioning as well as the original casting.



*(Photos courtesy Air Reduction Sales Co.)*

Fig. 2—Repaired by a Combination of Flame Straightening, Welding and Fabrication, the Casting Was Returned to Service at a Saving of Approximately $900.00.

* Assistant Superintendent of Motive Power, Milwaukee R.R.

# Proposed Recommended Practices for Resistance Welding

## 4. Standard Methods for Mechanical Testing of Resistance Welds

THERE follows another in the series of recommended practices for resistance welding being prepared by the AMERICAN WELDING SOCIETY Resistance Welding Committee.* This Standard has not yet been approved and is published here for the purpose of eliciting comments and suggestions. To be considered, correspondence regarding this standard should be addressed to the Secretary, A.W.S. Resistance Welding Committee, AMERICAN WELDING SOCIETY, 33 West 39th St., New York 18, N. Y., so that it arrives not later than December 16, 1944.

### GENERAL

These standards do not include the testing of base material. Only material will be used that conforms to the required material specification and it is the purpose of this Committee to recommend tests that are in common use that will determine the quality of a resistance weld. Spot, roller spot, seam and projection welds are covered for all ferrous and nonferrous alloys excepting aluminum and magnesium alloys. Drawings or, specifications utilizing these standards should specify the type or types of tests and the acceptable limits, as this will depend upon the design of fabricated parts.

*Single Spot Welds.*—The tests given herein have been written on the basis of single spot welds, but are applicable to the other method of resistance welding as shown.

*Roller Spot Welds.*—Roller spot welds are to be treated the same as single spot welds, the sample to be prepared as a multiple and cut into the specimens recommended for spot welds.

*Seam Welding.*—Seam welding is an extension of the spot-welding principle to a condition where the spots overlap providing a continuous weld.

*Projection Welds.*—Tests as established for spot welds also apply to projection welds, the projections being made in the sample strip at the point shown for the spot location. The projections are to be as shown in the A.W.S. Recommended Practices for Projection Welding.

### 1. TYPES OF TESTS

*1.1. Spot Welds.*—The size of weld depends upon thickness of material and is to comply with AMERICAN WELDING SOCIETY Recommended Practices for Spot Welding.

Test No. 1—Tension-shear test
Test No. 2—Tension test
- (*a*) Cross-tension test
- (*b*) U-tension test

Test No. 3—Impact test
- (*a*) Shear-impact test
- (*b*) Tension-impact test

Test No. 4—Fatigue test
Test No. 5—Macroetch test

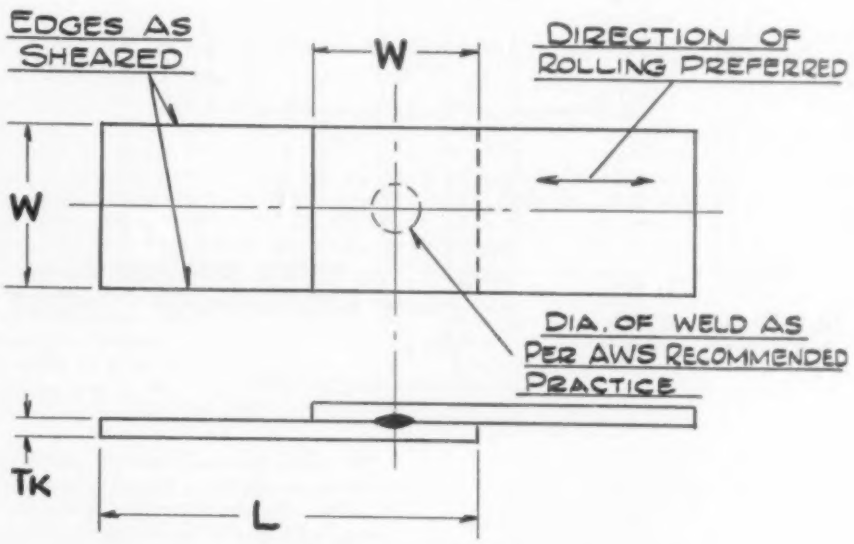
*1.2. Roller Spot Welds.*—The size of weld depends upon thickness of material and is to comply with AMERICAN WELDING SOCIETY Recommended Practices for Spot Welding.

Test No. 1—Tension-shear test
Test No. 2—Tension test
- (*a*) Cross-tension test
- (*b*) U-tension test

Test No. 3—Impact test
- (*a*) Shear-impact test
- (*b*) Tension-impact test

Test No. 4—Fatigue test
Test No. 5—Macroetch test

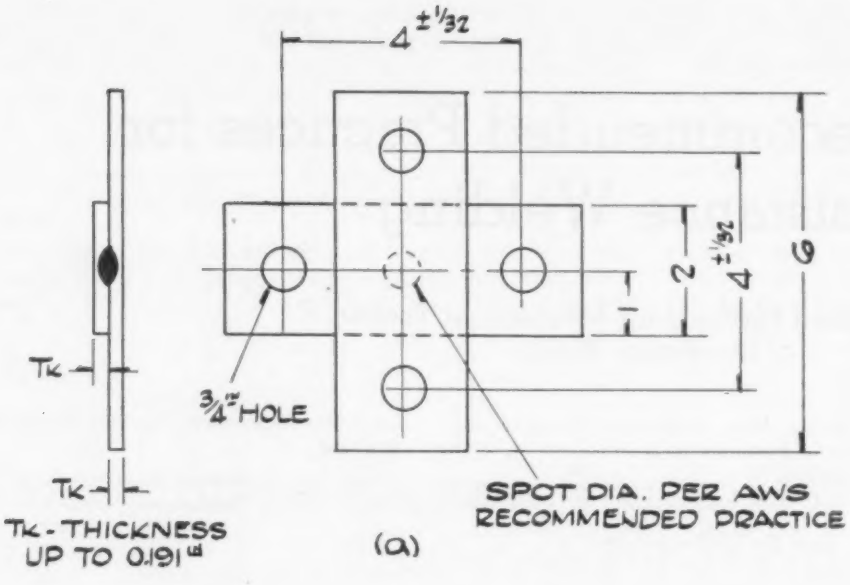
*1.3. Seam Welds.*—The size of weld depends upon thickness of material and is to comply with AMERICAN WELDING SOCIETY Recommended Practices for Seam Welding.




| TK · SHEET THICKNESS IN INCHES AND USS GAGE | W SPECIMEN WIDTH IN INCHES | L RECOMMENDED LENGTH |
|---|---|---|
| UP TO .029 INCL. UP TO 23 GAGE INCL. | 5/8 | 3 |
| .030 TO .058 INCL. 22 TO 17 GAGE INCL. | 1 | 4 |
| .059 TO .115 INCL. 16 TO 12 GAGE INCL. | 1½ | 5 |
| .116 TO .190 INCL. 11 TO 7 GAGE INCL. | 2 | 6 |
| .191 & OVER 6 GAGE & OVER | 3 | 8 |

Fig. 1—Tension-Shear Test Specimen.
For All Metals Except Aluminum, Magnesium and Their Alloys

* See August 1944 WELDING JOURNAL for Spot and Seam Welding Recommended Practices; see September 1944 WELDING JOURNAL for Flash Welding Recommended Practices.



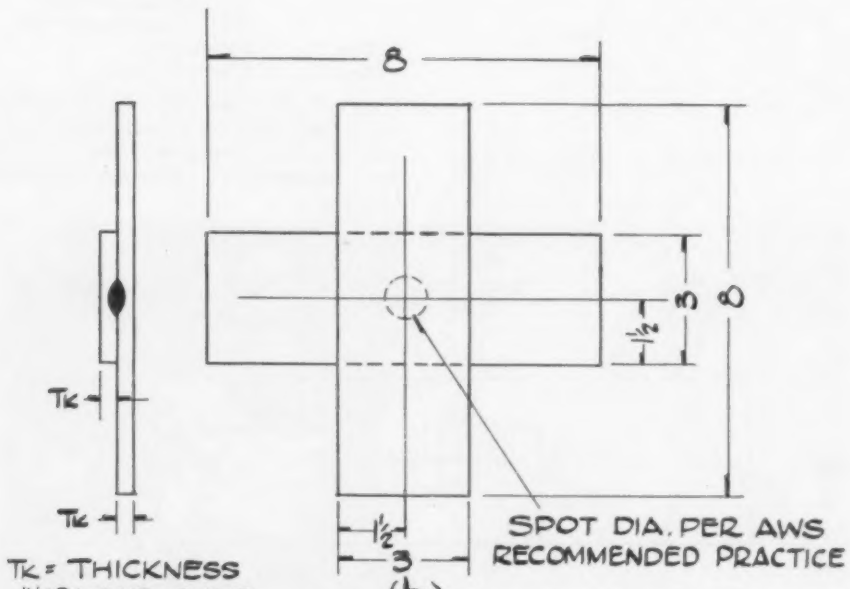




Fig. 2—Cross-Tension Test Specimen

Test No. 5—Macroetch test
Test No. 6—Pillow test

*1.4. Projection Welds.*—The size of weld depends upon thickness of material and is to comply with AMERICAN WELDING SOCIETY Recommended Practices for Projection Welding.

Test No. 1—Tension-shear test
Test No. 2—Tension test
(*a*) Cross-tension test
(*b*) U-tension test
Test No. 3—Impact test
(*a*) Shear-impact test
(*b*) Tension-impact test
Test No. 4—Fatigue test
Test No. 5—Macroetch test

## 2. METHODS OF TESTING

*2.1. Tension-Shear Test.*—This test shall consist of pulling in tension to destruction on a standard testing machine a test specimen obtained by lapping two strips of metal and joining them by a single weld.

The ultimate strength of the specimen, the diameter of the weld and the manner of failure, whether by shear of the weld metal, or by tear of the parent metal, and whether a ductile or brittle fracture, shall be recorded. The dimensions of the test specimens shall be as shown in Fig. 1.

The record of the specimen shall also include a complete description of the properties of the metal such as gage thickness, tensile strength, ductility and chemical composition.

The effect of eccentricity in the use of the above specimens may be disregarded. For specimens 0.116 in. in thickness and over it is recommended that the grips of the testing machine be offset to avoid bending at the grips.

*2.2. Tension Tests.*—(*a*) *The Cross-Tension Test:* This tension test is designed to stress the weld in a direction normal to the surface of the material. Special holding jigs are constructed to apply the normal tension to the welded cross specimen which is shown in Fig. 2, *a*, *b* and *c*.

The jig for holding the 2-in. x 6-in. cross specimen (Fig. 2 (*a*)) is shown in Fig. 3. Various methods of holding the jig in the testing machine may be used such as pin connections, wedge grips or threaded end testing fixtures. A self-aligning feature is desirable. Precautions should be taken to prevent the specimen from slipping in the holding fixture.

The jig for holding the 3-in. x 8-in. cross specimen (Fig. 2 (*b*)) is shown in Fig. 4 (*a*), which shows one of the specimens in the lower portion of the testing jig.

Tension at right angles to the plates of this specimen is produced by applying compression to the jig holding the specimens. The U-shaped yokes with the hold-down screws are used to partially restrain the specimen from bending by introducing semi-fixed ends to the beam represented by each separate plate. Fig. 4 (*b*) shows the specimen completely assembled in the jig with the compression head of the testing machine in contact with the jig and ready for applying load to the specimen.

(*b*) *The U-Tension Test:* The tension test may also be made on U-shaped specimens as shown in Fig. 5. The U sections are to be welded as shown and pulled in a standard testing machine to destruction. Supporting or spacer blocks must be prepared as shown for confining the sample so that loading takes place at the spot weld.

The ultimate strength of the weld, the diameter of the weld slug and the method of fracture shall be recorded.

This test is limited to those thicknesses and materials that can be readily formed.

The purpose of the tension test is to provide a better measure of notch sensitivity than is obtained with the tension-shear test. The ratio of the tensile strength to the tension-shear strength is frequently referred to as the "ductility" of the weld.

*2.3 Impact Test.*—Two types of impact tests are in use. The shear-impact test is recommended as the most rapid for material up to and including 0.125 in. thick. For thicknesses above 0.125 in., the drop impact test must be used. Material under 0.300 in. in thickness must be backed up with a reinforcing plate (see Fig. 2 (*c*)).

(*a*) *Shear-Impact Test:* The impact test differentiates between different degrees of weld toughness. A satisfactory shear-impact test for spot welds may be obtained by using the 2-in. x 6-in. tension-shear specimen, Fig. 1, and a modified 110 to 220 ft.-lb. pendulum type impact testing machine. To satisfactorily test welds in sheets up to and including 0.125 in. in thickness it is necessary to have bobs of different weights. Two interchangeable bobs made from magnesium alloy and steel are commercially available. These provide 30 to 60 and 110 to 220 ft.-lb. testing capacities, respectively.

Two-inch sheet metal testing attachments are commercially available. In this type of test the specimen is held by serrated wedge grips in the special pendulum bob and cross head attachments. When the machine is operated both the cross head and bob, which are connected by the welded specimen, fall until the cross head is caught by adjustable anvils at the bottom of the pendulum swing. The pendulum bob is free to continue its swing, and will do so, provided sufficient energy is

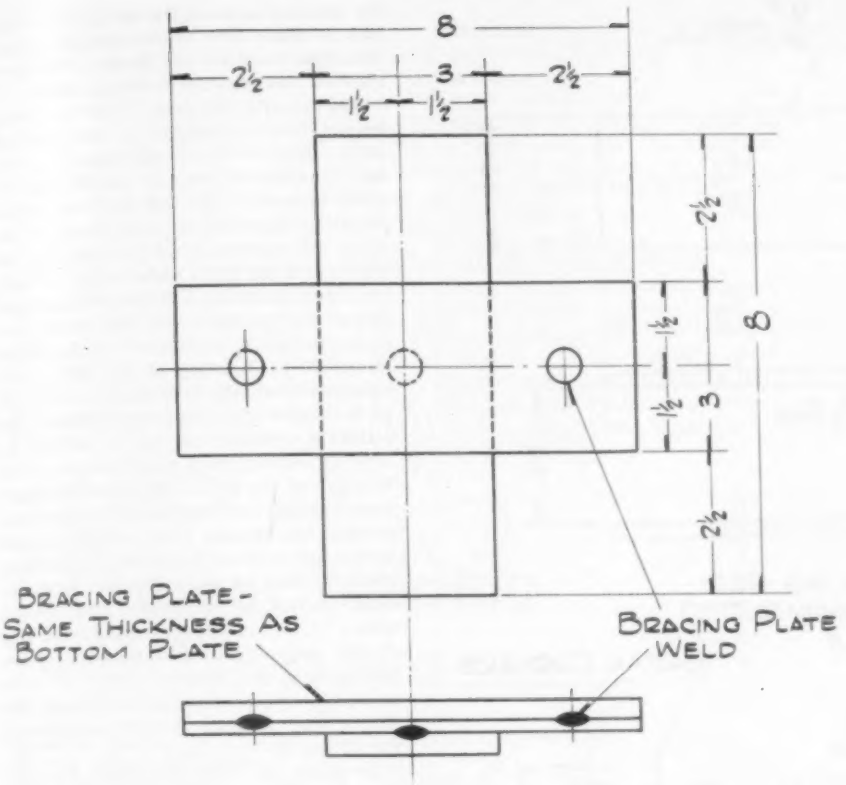



Fig. 2 (c)—Modified Cross-Tension and Drop-Impact Specimen

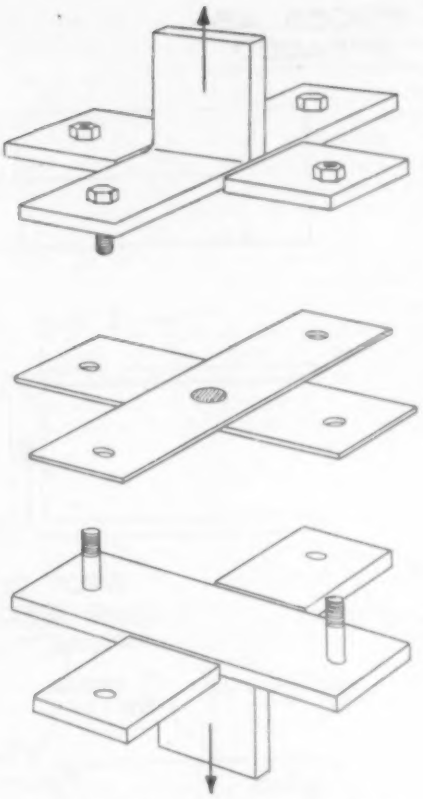


Fig. 3—Jig for Cross-Tension Test. For Material Up to and Including 0.191 In. in Thickness

available to fracture the specimen. The residual swing of the pendulum indicates the impact load in ft.-lb. necessary to break the spot weld. Care must be taken to properly tighten the wedge grips so that no errors are introduced by slippage of the specimen during test. If grip slippage is a serious problem, pin connections may be used to supplement the grips.

When making shear-impact tests some of the energy is absorbed in plastic deformation of the sheets. In order to control the extent of this deformation the distance between grips shall be 5 in., $-0 + 1/16$ in.

Since large changes in spot-weld impact strength occur with relatively small changes in sheet thickness and weld size, the coverage obtained by any one bob assembly is limited.

(*b*) *Drop-Impact Test:* Since the range of the ordinary pendulum-type impact testing machine will not permit shear-impact tests to be made on spot-welded sheets of thickness much greater than 0.125 in., a different procedure must be used to apply shock loads to spot welds in the heavier gage materials. The most critical direction in which a shock load may be applied to spot welds in heavy plate is in a direction normal to the plate surfaces. This may be accomplished using the same size and type of specimens recommended for the cross-tension test as shown in Fig. 2. In order to apply an impact load to a specimen of this type, a modified Fremont-type impact testing machine, which is commercially available, may be used. Weights of 50 or 100 lb. may be dropped from a height of 11 ft. to obtain maximum available energy values of 550 or 1100 ft.-lb. This range covers the usual impact strength values of heat-treated spot welds made in plain carbon and alloy steel combinations in plate thickness up to $1/2$ in. In order to obtain adequate velocity of impact it is recommended that the weights be dropped from heights 3 ft. and greater (approximately 14 ft./sec.). In order to reduce the bending of the specimen as much as possible, it is clamped by means of hold-down straps.

The residual energy after fracture is measured by means of a pair of calibrated springs. The maximum deflection of the springs may be indicated by an aluminum push rod moving between a pair of bronze friction plates. The amount of friction may be controlled by means of spring-loaded machine screws. An arm on the aluminum push rod provides a convenient place for a dial gage to be used to measure the maximum deflection of the springs (Fig. 6). A calibration curve for residual energy can be obtained by dropping the weight from various heights corresponding to various potential energies of the moving system. The falling weight is guided by means of lubricated ways. The lower portion of the weight is forked to permit the weight to be applied to both sides of the lower plate of the specimen. The width of

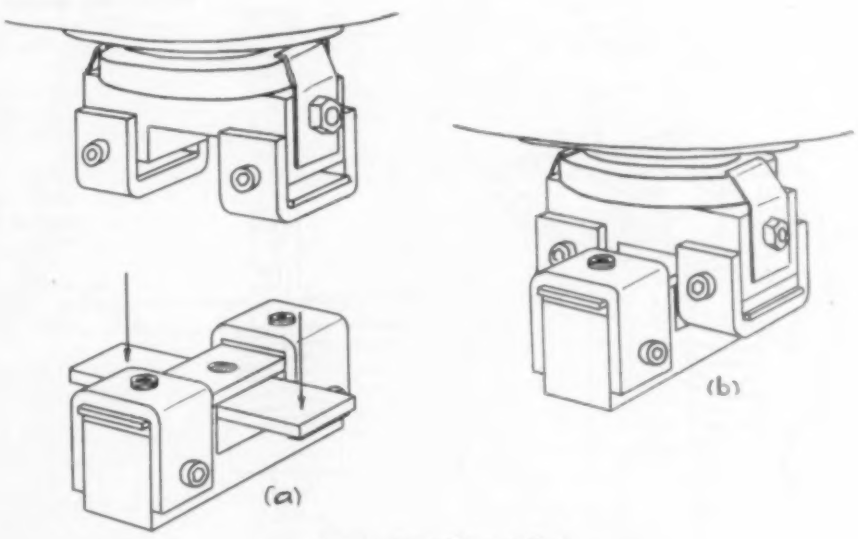



Fig. 4—Cross-Tension Test. For Material Over 0.191 In. in Thickness

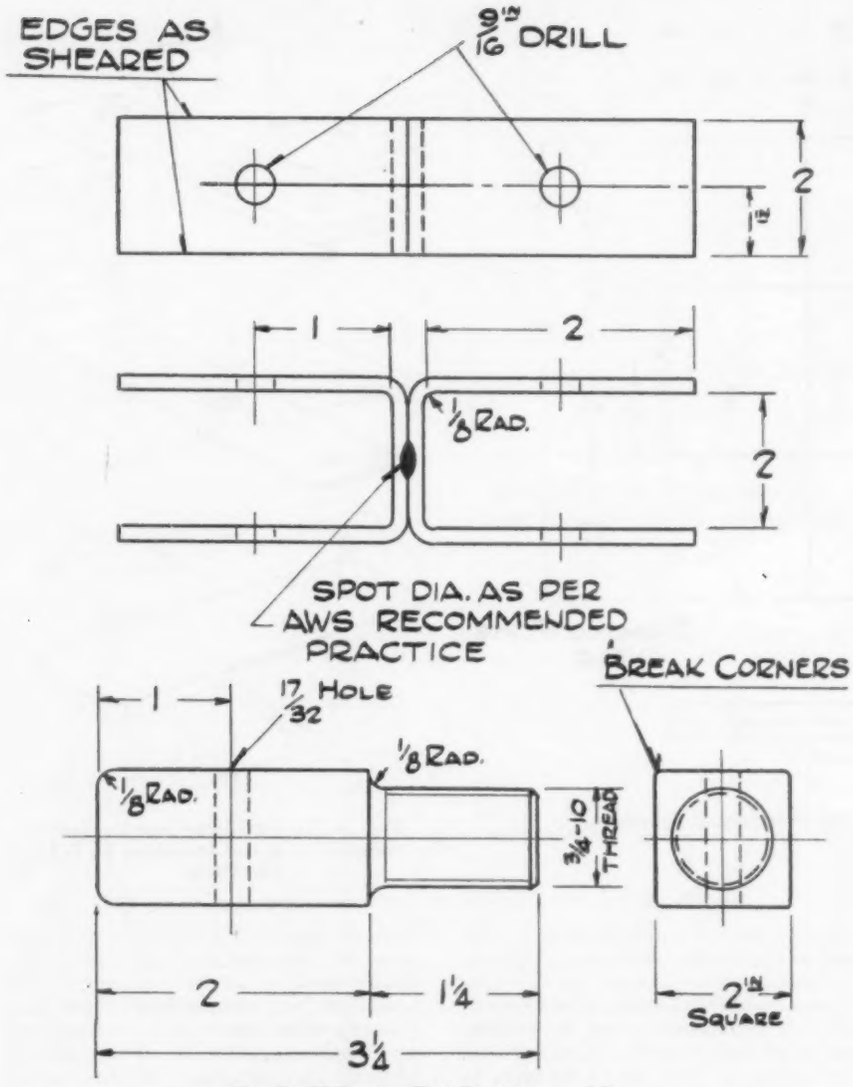



Fig. 5—U-Tension Test Specimen and Jig.
May Be Used with Thickness That Can Be Formed Readily

the opening between the two prongs of the fork is made $3^1/_8$ in. to permit a small clearance between the inside surfaces of the fork and the clamped upper plate.

The results obtained with the drop-impact test are subject to two types of error. Both of these are concerned with the behavior of thinner plates and the softer types of steel. One source of error is due to the fact that it is not possible to restrain the lower plate against bending. In this case, if the lower plate is thin and soft, too much bending will be produced and either the specimen will not break or a large portion of the impact energy will be absorbed in bending of the plate. Although the ability of a weld to force the plate to bend may be a good indication, the resultant impact energy absorbed by bending will not be a good measure of the strength of the weld. On the other hand, severe plastic deformation of the plate material in the vicinity of the weld is a much better index of weld quality. Therefore, plate bending at some distance from the weld should be avoided. The second source of error in impact testing is bending of the upper plate and slippage of the specimen in the clamps. Both of these cause absorption of additional energy, and thus a true measure of weld toughness is not obtained.

In order to avoid the possibilities for error mentioned above, two methods may be used to minimize bending and grip slippage in the upper plate. One is to provide serrated jaws for clamping to prevent slippage. The other is to place another plate directly over the upper plate and to attach these plates at their ends by additional spot welds, as illustrated in Fig. 2 (*c*). In this case the extra plate is placed in compression during the test, an action which prevents excessive plate bending due to grip slippage. In case the problem is concerned with welding thin plate to a thicker one, the heavier plate is arranged to be struck by the falling weight and the precautions mentioned above with refer-

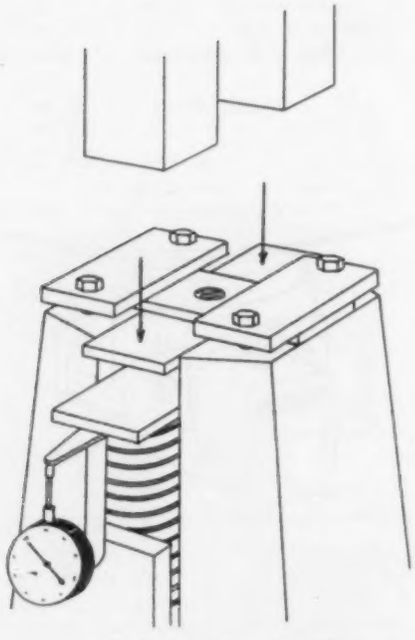


Fig. 6—Drop-Impact Test

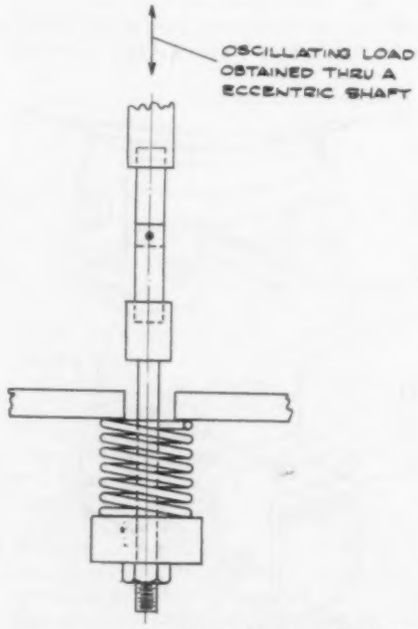



Fig. 7—Section View of Fatigue Testing Machine

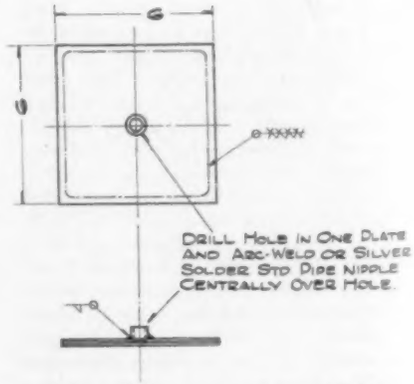



Fig. 8—Pillow Test for Seam Welds

ence to the upper plate will insure a satisfactory impact test. If both plates are thin and soft, it may be necessary to reinforce the lower plate in a manner similar to that used to stiffen the upper plate.

*2.4. Fatigue Test (Tension-shear):* The tension-shear fatigue test makes use of the tension-shear specimen, Fig. 1. Mounting holes must be drilled using utmost care to align the holes with the weld. The specimen is loaded in tension with a static load. A dynamic load is then applied and the dynamic load oscillated until failure of the specimen takes place (Fig. 7).

*2.5. Macroetch Test:* The purpose of this test is to determine the weld diameter and penetration as a shop control measure.

To prepare the specimen lay a straight edge across the weld and scribe a line on a diameter of the weld as judged by eye. Saw to one side of the line, filing or grinding the specimen to the line. Etch until satisfactory definition is obtained between the weld zone and the unaffected base metal. The weld diameter and penetration may be measured with a microscope.

For suitable etching solutions see A.S.T.M. Specification E 3, latest revision, or A.S.M. Metals Handbook.

This test is intended as a quick check and its accuracy depends upon the care taken in the preparation of the sample. Where more accurate work is required the samples will require mounting and careful preparation to obtain the true diameter.

*2.6. Pillow Test:* Seam welding is an extension of the spot-welding principle to a condition where the spots overlap providing a continuous weld. This continuous weld is only used where it is necessary to contain some liquid or gas and it is rarely a question of the strength of the weld. A test approaching operating conditions therefore furnishes the best measure of the weld quality. For this purpose two flat plates, the same thickness as the work (Fig. 8), are prepared and welded around the outside edge sealing the space between the plates. A pipe connection is then welded to the whole as shown in Fig. 8 and the assembly attached to a hydraulic system. Pressure is then applied to failure. The measure of a good weld is to have failure occur in the base metal.

---

# Current Welding Literature

Accident Prevention. Electric Welding, H. G. Taylor. Elec. Rev., vol. 134, no. 3469 (May 19, 1944), pp. 692–693.

Airplane Manufacture, Finishing. Method of Maintaining Smoothness of Airplane External Surfaces, A. H. Petersen. Automotive & Aviation Industries, vol. 91, No. 4 (Aug. 15, 1944) pp. 18–19, 104.

Airplane Manufacture. Place of Spotwelding in Aircraft Industry, D. E. Dawson. Western Metals, vol. 2, no. 6 (June 1944), pp. 7–9.

Airplanes, Fuel Tanks. Welded Fuel Tanks for Our Light Coastal Craft, H. G. Taylor. Sheet Metal Industries, vol. 20, no. 207 (July 1944), pp. 1249–1252.

Alloy Steel. Influence of Hydrogen on Weldability of High Tensile Alloy Steels, E. C. Rollason. Inst. Welding—Trans., vol. 7, no. 2 (July 1944), pp. 74–75.

Alloy Steel. Researches in Alloy Steel Welding. Inst. Welding—Trans., vol. 7, no. 2 (July 1944), pp. 43–74. (Reproduced in THE WELDING JOURNAL.)

Alloy Steel. Suggested Cause and General Theory for Cracking of Alloy Steels on Welding, G. L. Hopkin. Inst. Welding—Trans., vol. 7, no. 2 (July 1944), pp. 76–78.

Aluminum Alloys. Joining Aluminum Alloys, E. C. Hartmann, G. O. Hoglund and H. A. Miller. Steel, vol. 115, no. 6 (Aug. 7, 1944), pp. 84–85, 122, 124, 126, 128, 132, 134, 136, 138; No. 7 (Aug. 14), pp. 102, 148, 150, 152, 154, 156; No. 8 (August 21), pp. 110, 113, 116, 156, 158, 160, 162; No. 9 (Aug. 28), pp. 96, 99–100, 124, 126; No. 10 (Sept. 4), pp. 102, 105–106, 140; No. 11 (Sept. 11), pp. 116, 156, 158, 160, 162, 164.

Automobile Maintenance and Repair. Reclamation of Automotive Valves, N. Hoertz. Soc. Automotive Engrs.—J., vol. 52, no. 9 (Sept. 1944) (Trans.), pp. 430–435.

Automobile Manufacture. Scope, Application, and Development of Welding Processes in Automobile Production, J. P. Blundell. Sheet Metal Industries, vol. 20, no. 207 (July 1944), pp. 1241–1248, 1256.

Barges, Steel. Navy All-Welded Steel Barge, A. E. Niederhoff. Western Construction News, vol. 19, no. 8 (Aug. 1944), pp. 73–76.

Barges, Welded. All-Welded Barges Feature Fabricating Operations at Warren City Manufacturing Company. Steel Processing, vol. 30, no. 6 (June 1944), pp. 366–367, 385.

Boiler Manufacture, Textbooks. Laying Out for Boiler Makers and Plate Fabricators, revised by G. M. Davies. 5th ed. Simmons-Boardman Publishing Corp., New York, 1944. 522 pp., illus., diagrs., charts, tables, $7.00.

Brazing. Copper Brazing as Production Tool, C. L. Hibert. Automotive & Aviation Industries, vol. 91, no. 3 (Aug. 1, 1944), pp. 32–35, 67–68, 70, 74, 76, 78.

Brazing, Electric. Controlled Atmosphere Furnace Brazing, A. K. Phillippi. Steel Processing, vol. 30, no. 8 (Aug. 1944), pp. 517–519.

Brazing. Selective Copper Brazing in Salt Baths. Indus. Heating, vol. 11, no. 7 (July 1944), pp. 1099–1100.

Brazing. Silver Brazing 4.2 Mortar Shells. Industry & Welding, vol. 17, no. 7 (July 1944), pp. 36–37, 40.

Cast Iron, Acid Resisting. Centrifugal Casting Process, J. E. Hurst. Machy. Market, no. 2280, 2281 (July 14, 1944), pp. 275–276 (July 21), pp. 285–287.

Cast Iron, Acid Resisting. Improvements in Acid Resisting Silicon Iron Alloys, J. E. Hurst. Indus. Chemist, vol. 20, no. 235 (Aug. 1944), pp. 435–438, (discussion), 438–439.

Coal Mines and Mining, Equipment. Maintenance and Repair of Colliery Plant and Machinery, J. Rainford. Instn. Min. Engrs.—Trans., vol. 103, pt. 6 (Mar. 1944), pp. 285–296, (discussion), 296–303.

Electric Cables. New Method for Welding Cables, H. Guenther. Engrs.' Digest (British Edition), vol. 5, no. 5 (May 1944), pp. 146–148.

Electric Meters. Thermal-Demand Indicators on Intermittent Loads, P. Schiller. Elec. Times, vol. 105, no. 2738 (Apr. 13, 1944), pp. 429–430.

Electric Welding, Arc. Atomic Hydrogen Arc Welding, W. J. Van den Akker. Steel, vol. 115, no. 3 (July 17, 1944), pp. 114, 116, 166.

Electric Welding, Arc. Automatic Welding of NAX 9115 Sheet, A. H. Scheffer. Industry & Welding, vol. 17, no. 7 (July 1944), pp. 33–35.

Electric Welding, Arc. Gas-Shielded Arc Welding, R. F. Wyer. Gen. Elec. Rev., vol. 47, no. 7 (July 1944), pp. 21–26.

Electric Welding, Arc. Single-Operator A. C. Welding Sets. Elecn. vol. 132, no. 3435 (Mar. 31, 1944), p. 271.

Electric Welding Machines. Heat Losses in Welding Circuits. Industry & Welding, vol. 17, no. 6 (June 1944), pp. 34–37.

Electric Welding, Power Supply. Balancing Equipment for Electric Butt Welding Plant. Beama J., vol. 51, no. 86 (Aug. 1944), pp. 280–281.

Electric Welding, Power Supply. Causes of Variation in Welding Current, J. S. Wright. Industry & Welding, vol. 17, no. 7 (July 1944), pp. 41–42.

Electric Welding, Power Supply. Supplies to Electric Welding Plant, G. W. Stubbings. Mech. World, vol. 116, no. 2005 (Aug. 4, 1944), pp. 123–124.

Electric Welding, Power Supply. Welding Current Distribution System Saves Time and Space, C. E. Schirmer. Industry & Power, vol. 47, no. 3 (Sept. 1944), p. 73.

Electric Welding. Resistance Welding in Aircraft, O. A. Perry and H. D. Hager. Iron Age, vol. 154, no. 7 (Aug. 17, 1944), pp. 66–71.

Electric Welding, Resistance. Spot Welding, C. W. Besserer, Jr. Southern Power & Industry, vol. 62, no. 7 (July 1944), pp. 98–102.

Electric Welding, Resistance. Spot Welding Heavy Steel Sections, F. A. Lee. Steel, vol. 115, no. 8 (Aug. 21, 1944), pp. 98–101, 144, 146, 148, 150, 152.

Electric Welding Machines. Multi-Operator Welding Equipment. Elecn., vol. 132, no. 3436 (Apr. 7, 1944), pp. 297–298; see also Elec. Times, vol. 105, no. 2736 (Mar. 30, 1944), pp. 374–375

Electric Welding Machines. Electric Resistance Welding, L. B. Wilson. Elecn., vol. 132, no. 3435 (Mar. 31, 1944), p. 279; see also Elec. Times, vol. 105, no. 2736 (Mar. 30, 1944), p. 375; Elec. Rev., vol. 134, no. 3463 (Apr. 7, 1944), p. 484.

Fans, Manufacture. Use of Standardized Specifications and Production Controls for "Special" Fabricating Problems, M. S. Kice. Industry & Welding, vol. 17, no. 6 (June 1944), pp. 31–33, 80–82, 84.

Forge Shop Practice. Upset Forging in Welding Machine, D. B. Wilkin. Engineering, vol. 157, no. 4094 (June 30, 1944), p. 517.

(*Continued on page 1040*)

# Metallic Arc Welding Electrodes*

By Harold Lawrence†

## Part I—Stainless Steel Electrodes

AS WOULD be expected, the war has stimulated the application of stainless steel metallic arc-welding electrodes as has been the case with thousands of metallurgical tools. Heretofore the lion's share of the stainless steel electrodes has gone into the chemical and food processing industries where welding materials were required to match the corrosion-resisting properties of the stainless irons and steels.

During the war this same use has continued at an accelerated rate but even more important has been the adoption of stainless electrodes for welding armor on tanks and ships. This latter use developed from two very desirable properties of the stainless steel electrode types: first, the good physical properties associated with stainless weld deposits; and, second, the remarkable freedom from heat-affected zone cracking in hardenable steels specified for armor plating.

Although this series of articles has tried to stress the welding electrodes, it has been necessary to cover steels in a limited manner to provide essential background information for the correct selection of arc-welding electrode grades. When stainless materials are under discussion, the relationship that exists between the plate materials and the filler metal deposited by arc-welding electrodes is, if anything, even more important. Therefore the first phase of this article will be devoted to a consideration of six well-known stainless grades.

In 1943 the American Iron and Steel Institute reported the production of stainless steel by specific analysis groups and these are shown in Fig. 1. Over half the steel made was of the 18–8 (in discussing stainless steels it is customary to show the chromium content first followed by the nickel content) composition which very likely included allied types such as 18–8 columbium and 18–8 molybdenum. The second most important tonnage was the 12 to 14% chromium analysis with the high chromium and high chromium-nickel grades contributing the next large block. The smallest tonnage subdivision was the 16 to 18% chromium composition.

Stainless steels are commonly classified according to their A.I.S.I. (American Iron and Steel Institute) numbers which refer to specific ranges of principal elements. Thus the six types to be covered in this study are A.I.S.I. 308, 347, 316, 310, 410 and 430. The reasons for selecting these particular types will become obvious.

*A.I.S.I. Type 308, 18–8 Stainless Steel.*—Some liberty will be taken when the A.I.S.I. names and numbers are given together. This becomes necessary for consistency with arc-welding practice where higher analyses are selected to provide a margin of safety for losses of essential elements during arc transfer. While type 308 is more properly a 20–10 type, it is here considered as an 18–8. And electrodes with Type 308 core wire are often used for the following 18–8 types: AISI 301X, 302, 304 and 308.

Stainless steels are those containing more than 10% chromium. They may or may not have nickel in their composition. Those without nickel are classified as ferritic and are magnetic. Those with nickel are classified as austenitic and are nonmagnetic. A simple permanent magnet provides a ready means of identification.

All of the stainless steels have some unusual properties that have a pronounced effect on weldability. Those important to the austenitic chrome-nickel steels are: (1) 40 to 50% less thermal conductivity than mild steel, (2) 6 to 12 times greater electrical resistance than mild steel, (3) 50% greater thermal expansion than mild steel and (4) a slightly lower melting point than mild steel.

### Features of 18–8 Stainless

The reduced thermal conductivity means that a lower welding current can be used to secure satisfactory welds and also suggests a retention of heat adjacent to the weld with a slow cooling of both the weld and the heat-affected zone. With 18–8 stainless steels slow cooling of the parent steel alongside the weld leads to trouble. This difficulty concerns itself with the phenomenon of carbide precipitation which renders 18–8 susceptible to intergranular corrosion.

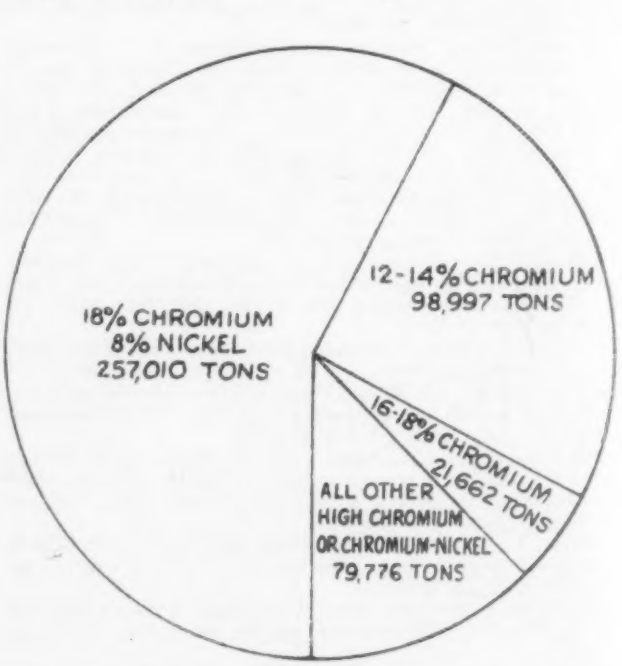



Fig. 1—Distribution of 457,448 Tons of Stainless Steel Produced in the United States in 1943 as Reported by the American Iron and Steel Institute

* Mr. Lawrence resumes his outstanding series in *Steel* on selection of proper electrodes for specific applications. Reprinted from *Steel* starting with Sept. 11, 1944 issue.

† Metallurgist and Welding Engineer.

In the range of 800 to 1500° F. 18–8 stainless steel undergoes a structural change with the carbon separating out in the form of chromium carbide along the grain boundaries. By so doing the steel alongside the grain boundaries becomes poor in chromium and thereby unable to resist many corrosive media.

Carbide precipitation is influenced by at least four factors: (1) time in the critical temperature range; (2) temperature reached; (3) carbon contained; and (4) chromium and nickel contents. The longer the time in which the 18–8 remains in the carbide precipitation temperature range, the more acute will be carbide formation and chromium depletion at the grain boundary region. As the temperature increases from 800 to 1500° F., the rate of carbide formation becomes different with the most rapid development of chromium carbides occurring in the neighborhood of 1200° F. Higher carbon contents provide the carbon essential to the chromium carbide compound which accounts for a more pronounced attack in the higher carbon austenitic steels where conditions favorable to intergranular corrosion have been allowed. Increased chromium and nickel contents with a constant carbon content diminish the harmful effect of carbide formation with a 20–10 analysis being a better type than an 18–8.

Carbide precipitation is important only when the degree reached permits corrosive attack in the service for which the weldment was designed. In mild corrosive environments the presence of chromium carbides may be of no significance. Since the physical properties are virtually unaffected, carbide formation is inconsequential where physical attributes rather than corrosion resistance dictated the selection of an 18–8 analysis.

There are two ways of combatting carbide precipitation. The first is a cure and the second is a preventive. Austenitic stainless steel containing chromium carbides at the grain boundaries can be heated to 1850 to 1900° F. and held for a long enough period to bring about a solution of the carbides. Next a rapid cool to a temperature below 800° keeps the carbon uniformly dissolved. But there are some weldments that cannot be treated so drastically. For these the preventive in the form of a columbium or titanium bearing steel is indicated.

*A.I.S.I. Type 347, 18–8 CB Stainless Steel.*—Since the 18–8 stainless steels were readily fabricated by welding, it was apparent that some means to overcome the objectionable formation of chromium carbides would greatly extend the utility of this analysis. A stabilizing element was sought and was eventually discovered in both columbium and titanium. The former proved useful in both plate and electrodes while the latter could be used in plate alone as it was entirely lost in passing through the welding arc. With suitable columbium and titanium contents heat-affected zones could pass through the 800 to 1500° F. range repeatedly without introducing any lessened corrosion resistance. Other than a slight deterioration in ductility, the other properties of the 18–8 remained substantially the same.

*A.I.S.I. Types 316–317, 18–8 MO Stainless Steel.*—Molybdenum modified stainless steel has been recognized for quite some time as a superior analysis to resist the pit type of corrosion. It has been used both with and without columbium in many services where its particular stainless properties were needed. In addition this analysis enabled the War Production Board to save enormous quantities of scarce chromium and nickel by proving most effective in the welding of armor that previously had to be done with 25–20 electrodes.

*A.I.S.I. Type 310, 25–20 Stainless Steel.*—Corrosion resistance is but one of the two particular properties of the stainless steels that account for their widespread use. Resistance to oxidation is the other. Thus the higher analyses are selected for services where the greater cost of these types is more than offset by increased life. Furthermore the more highly alloyed varieties show an almost complete freedom from carbide precipitation so no stabilization is required.

The Joint A.W.S.-A.S.T.M. Committee on Filler Metal has been hard at work for some time on matters relating to standards for filler metal. This committee consists of the following subcommittees:

Subcommittee I on Iron and Steel Arc-Welding Electrodes is under the chairmanship of the writer and has published its tentative specifications for iron and steel arc-welding electrodes for a number of years, the latest issue being Serial Designation A-233-43T. This specification is still, unfortunately, tentative and we are making still further revisions after which we are hopeful that it can lose its tentative state.

Subcommittee II on Iron and Steel Gas-Welding Rods is under the chairmanship of J. H. Critchett and has developed a specification, Serial Designation A-251-42T. These specifications are tentative and it is expected that revisions will be made to them during the year.

Subcommittee III on Aluminum and Aluminum Alloy Filler Metal is under the chairmanship of G. O. Hoglund and recently completed specifications for aluminum and aluminum alloy arc-welding electrodes. It has still the work of writing similar specifications for aluminum and aluminum alloy gas-welding rods. Their welding electrode specification carries Serial Designation B-184-43T.

Subcommittee IV on High-Alloy Steel Filler Metal is headed by R. D. Thomas as chairman. This subcommittee has been considering for a year or two now this most difficult specification and it is expected that they will report to their main committee shortly.

Subcommittee V on Nickel—Nickel Alloy Filler Metal has O. B. J. Fraser as chairman. This subcommittee has written a specification which includes the filler metal of nickel, Monel, inconel, illium and several hastelloy compositions, and it is hoped that they will report to their main committee and submit a specification shortly.

Subcommittee VI on Copper and Copper Alloy Filler Metal has C. E. Swift as chairman. This subcommittee is preparing specifications for copper and copper alloy electrodes and it is hoped that they will make a report in the near future.

Subcommittee VII on Hard Facing Materials—Much data have been collected on hard surfacing electrodes and their deposits. A new subcommittee has been approved but as yet no chairman has been nominated for this work.

J. D. Deppeler, *Chairman*
*Joint AWS-ASTM Committee on Filler Metal*

*A.I.S.I. Type 410, 13% Chromium Stainless Steel.*—Straight chromium stainless steels are selected either for resistance to corrosion or for high temperature service where oxidation must be fought. The physical properties of the straight chromium steels are somewhat different from those that were discussed under the chromium nickel steels.

The coefficient of expansion of the straight chromium steels approximates that of mild steel. Heat conductivity is half to two-thirds that of ordinary steel. Electrical resistance is three to six times that of plain steel. And melting points are only slightly less than those of the carbon steels.

Type 410 steel is unusual in several respects, first of which is the fact that it is hardenable. Response to heat treatment increases with carbon content as is commonly the case with all steels. It is a more difficult steel to weld than the chromium nickel varieties because of the formation of brittle deposits and heat-affected zones. It is not subject to intergranular corrosion resulting from carbide precipitation. Under all heat conditions the carbides stay in solution.

*A.I.S.I. Type 430, 17% Chromium Stainless Steel.*—There is little difference in behavior between Types 410

**Table 1—Typical Core Wire and Deposit Analyses of Popular Stainless Steel Electrodes**

| Common Name | A.I.S.I. Type | Analysis of | C | Mn | P | S | Si | Cr | Ni | Mo | Cb |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18-8 | 308 | Core wire | 0.07 | 1.75 | 0.03 | 0.03 | 0.40 | 20.5 | 9.5 | ... | ... |
| | | Weld deposit | 0.07 | 1.50 | 0.03 | 0.03 | 0.50 | 19.0 | 9.0 | ... | ... |
| 18-8 Cb | 347 | Core wire | 0.07 | 1.75 | 0.03 | 0.03 | 0.40 | 20.5 | 9.5 | ... | ... |
| | | Weld deposit | 0.07 | 1.50 | 0.03 | 0.03 | 0.50 | 19.0 | 9.0 | ... | 0.70 |
| 13-8 Mo | 316 | Core wire | 0.07 | 1.75 | 0.03 | 0.03 | 0.40 | 19.5 | 13.5 | 2.5 | ... |
| | | Weld deposit | 0.07 | 1.50 | 0.03 | 0.03 | 0.50 | 18.0 | 13.0 | 2.5 | ... |
| 25-20 | 310 | Core wire | 0.10 | 1.75 | 0.03 | 0.03 | 0.40 | 26.5 | 21.0 | ... | ... |
| | | Weld deposit | 0.15 | 1.50 | 0.03 | 0.03 | 0.50 | 25.0 | 20.0 | ... | ... |
| 13% Cr | 410 | Core wire | 0.10 | 0.75 | 0.03 | 0.03 | 0.40 | 13.0 | .. | ... | ... |
| | | Weld deposit | 0.10 | 0.75 | 0.03 | 0.03 | 0.50 | 12.0 | .. | ... | ... |
| 17% Cr | 430 | Core wire | 0.10 | 0.75 | 0.03 | 0.03 | 0.40 | 17.0 | .. | ... | ... |
| | | Weld deposit | 0.10 | 0.75 | 0.03 | 0.03 | 0.50 | 16.0 | .. | ... | ... |

and 430. Resistance to corrosion and oxidation improves with greater chromium content and the range of physical properties achieved through heat treatment varies. Oftentimes the plain chromium stainless steels are welded with chrome-nickel electrodes where corrosion response permits.

Thirteen manufacturers of stainless steel arc-welding electrodes are reported.* For convenience the types of electrodes made by each are given with specific information being restricted to the six most popular types now under discussion. It must be remembered that there are more than 30 types of stainless steel electrodes in use today with new combinations likely as the anticorrosion properties of still more alloy combinations come to the fore.

Chemical composition of core wire and weld deposit has been a matter of much interest to the users of stainless steel electrodes. It has been customary for the producers of these electrodes to vie with each other on the alloy content of the core wire used. First this was 18–8, later it became 19–9 and ultimately grew to 20–10 for the ordinary 18–8 welding work. Although greater alloy content in the core wire was a strong talking point, the composition of the deposited weld metal was the real consideration. Both of these analyses as selected by a majority of stainless steel electrode manufacturers are given in Table 1.

Some general and specific observations on chemical analyses ought to be in order. Certain elements are lost when passing through the arc. Of these chromium is the most important. Depending upon the type of coating employed, from 1 to 2% of chromium will be oxidized and unrecoverable in an 18–8 electrode. About one-third of the available columbium will be lost. Nickel and molybdenum will be unaffected by arc transfer. In all of these transfer efficiencies the coating design is most important. Lime type coatings lead to a greater recovery of oxidizable elements than do the titania type of coatings. However, the weld metal analysis from either type may be the same as it is customary in the industry to add elements to the coating to restore those percentages lost going through the arc.

* Editorial Note: Original articles in *Steel* contained names of manufacturers.

Some of the statements made in the above paragraph may differ slightly from the values found in Table 1. But when the added factor of spatter loss and dilution is considered these values may be more readily appreciated.

Carbon in the core wire and deposit is unchanged for all types except A.I.S.I. Type 310. There a rise in carbon from core to deposit is encountered. This situation is permitted because the increased carbon has no deleterious effect on corrosive properties. Manganese, in the chromium-nickel types, shows a loss from wire to deposit. Both phosphorus and sulphur are seemingly unaffected and thousands of analyses have substantiated this point provided that the coating ingredients are carefully selected to avoid weld deposit contamination. In all cases the silicon in the deposited metal is higher than that in the core and comes from a reduction of the sodium silicate binder. Chromium losses are found with all types. Nickel losses are indicated although seldom found. Molybdenum shows no loss while the columbium loss is difficult to appraise as columbium is added in two ways. It may be incorporated in the core wire or it may be added through the coating.

Table 2 presents the physical properties of the six principal stainless steel types. In general, the balance of properties among the austenitic chrome-nickel steels is better than those reported for the straight chromium nickel steels is better than those reported for the straight chromium varieties. Frequently chromium-nickel steels are selected for the welding of plain carbon steels because of the fine combination of strength and ductility secured in this fashion. For such uses the 18–8 and 25–20 types have been the most widely applied.

Current and voltage ranges shown in Table 3, are rather critical for stainless steel electrodes. Because of the increased electrical resistance of the core wire, it is not unusual for the electrode to overheat when slightly higher currents than those recommended are employed. The red or white hot wire tends to destroy coating adherence in addition to making porous welds. These reasons suggest restraint in the use of high currents if a loss of valuable electrodes is to be avoided. If the coating has been allowed to overheat, it is suggested that the stubs so produced be set aside until they have cooled thoroughly before they are used again. In this pro-

**Table 2—Typical Physical Properties of Popular Stainless Steel Metals**

| Common Name | A.I.S.I. Type | Tensile Strength, Psi. | Yield Point, Psi. | Elongation, % in 2 In. | Reduction of Area, % | Impact Strength, in Ft./Lb. Charpy | Impact Strength, in Ft./Lb. Izod | Endurance Limit, Psi. | Brinell Hardness |
|---|---|---|---|---|---|---|---|---|---|
| 18–8 | 308 | 80–95,000 | 35–45,000 | 35–50 | 40–65 | .... | 65–110 | 35,000 | 130–190 |
| 18–8 Cb | 347 | 80–95,000 | 35–50,000 | 30–50 | 40–65 | 77 | .... | 45,000 | 130–190 |
| 18–8 Mo | 316 | 80–95,000 | 35–45,000 | 35–50 | 40–65 | 70–110 | .... | 43,000 | 130–190 |
| 25–20 | 310 | 85–95,000 | 45–65,000 | 35–55 | 40–60 | 35–65 | .... | .... | 155–200 |
| 13% Cr | 410 | 65–85,000 | 35–45,000 | 20–35 | 50–65 | .... | 60–100 | .... | 130–170 |
| 17% Cr | 430 | 70–90,000 | 40–55,000 | 20–30 | 35–55 | .... | 8–25 | 50,000 | 145–185 |

**Table 3—Current and Voltage Ranges for Popular Types of Stainless Steel Electrodes**

| Common Name | A.I.S.I. Type | Diameter, In. | Voltage Range | Amperes | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Flat | Vertical | Overhead | Downhand Fillet and Groove | Horizontal Fillet |
| 18-8 | 308 | 1/16 | 23-24 | 10-40 | 10-40 | 10-40 | 10-40 | 10-40 |
| | | 5/64 | 24-25 | 20-55 | 20-55 | 20-55 | 20-55 | 20-55 |
| | | 3/32 | 25-26 | 70-80 | 50-65 | 70-80 | 70-80 | 70-80 |
| | | 1/8 | 26-27 | 120-130 | 80-100 | 80-105 | 120-130 | 120-130 |
| | | 5/32 | 26-27 | 135-150 | 100-120 | 110-125 | 135-150 | 135-150 |
| | | 3/16 | 26-27 | 150-170 | 110-130 | 130-145 | 150-170 | 150-170 |
| | | 1/4 | 27-28 | 220-250 | ..... | ..... | 220-250 | 220-250 |
| 18-8 Cb | 347 | 3/32 | 25-26 | 70-80 | 50-65 | 70-80 | 70-80 | 70-80 |
| | | 1/8 | 26-27 | 120-130 | 80-100 | 80-105 | 120-130 | 120-130 |
| | | 5/32 | 26-27 | 135-150 | 100-120 | 110-125 | 135-150 | 135-150 |
| | | 3/16 | 26-27 | 150-170 | 110-130 | 130-145 | 150-170 | 150-170 |
| 18-8 Mo | 316 | 3/32 | 25-26 | 70-80 | 50-65 | 70-80 | 70-80 | 70-80 |
| | | 1/8 | 26-27 | 120-130 | 80-100 | 80-105 | 120-130 | 120-130 |
| | | 5/32 | 26-27 | 135-140 | 100-120 | 110-125 | 135-150 | 135-150 |
| | | 3/16 | 26-27 | 150-170 | 110-130 | 130-145 | 150-170 | 150-170 |
| | | 1/4 | 27-28 | 220-250 | ..... | ..... | 220-250 | 220-250 |
| 25-20 | 310 | 3/32 | 25-26 | 70-80 | 50-65 | 70-80 | 70-80 | 70-80 |
| | | 1/8 | 26-27 | 120-130 | 80-100 | 80-105 | 120-130 | 120-130 |
| | | 5/32 | 26-27 | 135-150 | 100-120 | 110-125 | 135-150 | 135-150 |
| | | 3/16 | 26-27 | 150-170 | 110-130 | 130-145 | 150-170 | 150-170 |
| | | 1/4 | 27-28 | 220-250 | ..... | ..... | 220-250 | 220-250 |
| 13% Cr | 410 | 1/16 | 20-24 | 25-50 | 25-35 | 25-35 | 25-50 | 25-50 |
| | | 0.075 | 22-25 | 40-60 | 25-35 | 25-35 | 40-60 | 40-60 |
| | | 3/32 | 23-26 | 50-70 | 30-45 | 30-45 | 50-70 | 50-70 |
| | | 1/8 | 23-26 | 60-95 | 45-80 | 45-80 | 60-95 | 60-95 |
| | | 5/32 | 23-26 | 80-135 | 80-100 | 80-100 | 80-135 | 80-135 |
| | | 3/16 | 24-28 | 125-165 | ..... | ..... | 125-165 | 125-165 |
| | | 1/4 | 24-28 | 150-225 | ..... | ..... | 150-225 | 150-225 |
| 17% Cr | 430 | 3/32 | 25-26 | 70-80 | 50-65 | 70-80 | 70-80 | 70-80 |
| | | 1/8 | 26-27 | 120-130 | 80-100 | 80-105 | 120-130 | 120-130 |
| | | 5/32 | 26-27 | 135-150 | 100-120 | 110-125 | 135-150 | 135-150 |
| | | 3/16 | 26-27 | 150-170 | 110-130 | 130-145 | 150-170 | 150-170 |

cedure the greatest possible strength will be restored to the coating and the electrode may be applied successfully.

Current varies both with the position of welding and the type of material. Bead welding, groove welding and horizontal fillet welding permit the maximum use of current with vertical and overhead welding necessitating the selection of lower currents. Of course, allowable currents increase as the section being welded becomes greater. Or the welding of mild steels with stainless steel electrodes calls for higher currents.

## Stainless Electrodes Gain

Narrow ranges of voltage are listed because voltage and arc length are vital to the successful application of stainless steel weld metal. Usually the best results come from holding as short an arc as possible. The coating may touch the work although the operator should be sure that all slag formed floats free and does not become trapped in the weld metal. A close arc aids in the conservation of chromium which is more readily destroyed when a long arc is held.

Metallic arc welding of many products with stainless steel electrodes has grown most rapidly. An excellent matching of physical properties and chemical composition has been reached. As a matter of fact stainless steel applications of the metallic arc fusion welding process come the closest of all welding to making the deposited metal exactly like the plate material it is used to join.

Heavily coated electrodes are used. The coating is of either one or another basic type generally spoken of as lime or titania types. Cellulosic coatings may not be employed with stainless steel electrodes which accounts for the standardization on all mineral types for this field. In the lime type of coating calcium carbonate and calcium fluoride are the prime ingredients with other materials being added to round out desirable slag and welding characteristics. The titania type of coating depends upon pure $TiO_2$ along with other selected compounds of calcium and other minerals to give the required welding performance.

As was mentioned just briefly before, the lime type of coating is the least severe on chromium transfer through the arc. In some applications the slagging action of the lime type of coating has been preferred. Certain users have felt that the lime type coating gave superior performance in the vertical and overhead positions. Also some fabricators and consumers were inclined to feel that corrosion resistance might be better with deposits from lime-coated electrodes. But there has been too much supposition on some of these points and not enough actual test and field trial data. So far the predominant use of the lime type coating has been with d.-c., reverse polarity although at least one lime-coated electrode suitable for a.-c. welding is in process of development.

## Welder's Choice

If the welder were permitted to select the electrode to be used, his choice would be the titania type. It has a much more stable arc, less spatter and makes a smoother bead. In groove welding the titania type washes up along the side walls of the groove in excellent fashion

and compares quite favorably with an E6020 electrode in this respect. Titania coatings almost always contain ferrochromium and other ingredients designed to provide proper corrosion-resisting weld metal analyses. Principally used with direct current, reverse polarity, the titania type coating has permitted a.-c. applications as well and a number of manufacturers have announced such electrodes. Without a doubt the stainless steels will soon become another field to which the usual advantages of a.-c. welding will be extended. With the stainless steels magnetic disturbances are even more aggravating than with carbon steels, which will make a.-c. welding just that much more of a boon to those who employ it.

Before leaving this discussion of the relative merits of lime and titania stainless steels, it would be well to point out the history of these coatings. Both were developed close to the same time but in the early stages of stainless steel welding, more dependable results were obtained with the lime type coating. However, the knowledge of weld deposits and electrode performance is growing so rapidly that it is to be expected that the titania type will ultimately do everything that the lime type will do and vice versa. So far the lime type holds specific advantages in consistent physical properties while the titania type holds an edge in all phases of performance associated with smoother arc action and bead deposits, general ease of application in all positions and best performance to date with alternating current.

Storage of stainless steel electrodes is not as much a problem as some mild steel types present. A clean, dry space should be provided. Beyond this no special care is needed as most stainless steel coatings are unaffected by moisture. However, drying can be employed to get rid of any occluded moisture and because of the all mineral character of the coating, temperatures up to 400 to 500° F. can be employed without any detrimental effect on the coating. One hour of drying or even more can be used. It should be remembered that most stainless steel electrodes require no drying prior to use and these drying instructions are given for the exceptions only. Surface pitting is sometimes an indication of wet coating if a means for judging moisture is needed and a short bead on a clean plate will soon disclose whether or not the weld metal tends to pit.

### Applications Are Numerous

The applications of the stainless steel electrodes are quite numerous and only a few outstanding ones will be mentioned here. For 18–8 there is the dairy industry where it is used in milk coolers and separators, storage and shipping tanks and cheese vats. Extending the use in the food industry, all sorts of kitchen ware is made of 18–8 stainless. The petroleum industry uses 18–8 in valve seats on high pressure lines, for cracking tower linings (although straight chromium stainless is more often applied here) and other miscellaneous applications. Aircraft exhausts are welded with austenitic electrodes. Large castings of manganese steel are repaired and rebuilt with 18–8. Many types of dies are repaired with these electrodes and much chemical equipment is built and repaired with 18–8.

All of the uses listed under 18–8 apply to 25–20 but even more severe applications require the selection of the more highly alloyed material. In the welding of armor, 25–20 with a lime type coating has been a standby for some years. Likewise there are many industries which face unusual repair and maintenance problems from time to time. These jobs will encompass almost every known analysis of carbon and alloy steel. From long experience the welders have taken to 25–20 electrodes as a cure-all, for with a little preheating and the judicious application of short beads on almost any ferrous material they have succeeded in making substantial and crack-free welds on all sorts of equipment.

Stainless steel electrodes must be selected and applied with care. Matching of corrosion-resisting properties is of utmost importance. Usually the analysis used is specified by the ultimate consumer as he is the only one in a position to know the oxidation and corrosion service for which the stainless steel he desires is best fitted. As is true with all types of welding, reliable producers can be depended upon to aid in the proper choice of electrodes.

# Part II—Hard Surfacing Electrodes

ALTHOUGH the rapid growth of the metallic arc-welding industry has led to a certain complexity when available electrodes are investigated, nowhere is the difficulty quite as great as in the field of hard surfacing electrodes. Here there are hundreds of analyses varying in cost from a few cents to several dollars a pound. Unfortunately the cost of the electrodes bears little relationship to the efficiency of use to be expected from them. For some applications electrodes costing less than 20 cents a pound are the best choice while in other applications electrodes costing several dollars per pound are actually the cheapest in the long run.

Hard surfacing is done for a multiplicity of reasons. Obviously hard-faced equipment is longer lived in most services. Thus a machine or a part that has been given a proper wearing surface in those parts subjected to wear will last for a long while, making the cost of the equipment per hour of use considerably lower than would be found in a similar article constructed of ordinary machine steel notwithstanding the fact that this steel had been heat treated to optimum hardness.

Of course, all plant maintenance departments are set up to devise ways and means of preventing shut downs and delays. These are costly not only because of lost production but also because of the labor required to replace parts. Hard surfacing frequently supplies an answer to this problem and should be kept in mind as rising labor costs place an increasing premium on continuity of production.

Hard facing of ordinary steels provides an economical combination which frequently lasts longer than a part wholly constructed of alloy steel. S.A.E. 1045 steel has been very popular for providing a strong, tough base metal on which to apply a wear-resistant overlay.

Another advantage of hard surfacing lies in its ability to salvage and reclaim parts that would otherwise be slated for the junk pile. In those industries where replacement of worn parts is an everyday occurrence, regular hard surfacing departments are in continuous operation providing a steady flow of rebuilt sections. And more often than otherwise the replaced pieces yield more service than the original member. This situation has led a large number of plants building equipment that is liable to extreme wear to hard surface new parts so as to provide maximum life in the primary installation.

Power is saved when hard-surfaced equipment is operated. This situation exists because the entire machine performs best when no parts have deviated from original trueness or sharpness as a result of lost or displaced metal. In digging and grinding machinery this is especially true.

In addition to the power saved there is a general level of increased efficiency. With a minimum expenditure of effort, peak performance is maintained when dies are square and sharp or when bearings perform with good alignment and least friction.

Hard surfacing enables operators to keep their machinery in good operating condition by maintaining the desired dimensions with low cost rebuilding. Most hard facing electrodes permit the application of small amounts of metal exactly where needed. Since these deposits are both smooth and sound, little machining or grinding to the required tolerances is necessary.

Furthermore hard surfacing provides considerable flexibility in its use. If but a few square inches of hardened steel is sought, that area and that area alone need be surfaced. This condition permits the use of ordinary steel for the whole section instead of necessitating many pounds of expensive alloys to do the work of a few ounces correctly positioned by welding.

For metallic arc welding it is convenient to arrange the available electrodes into six groups. This method is fairly popular in the trade although the first group contains many analyses for a wide range of services. A short description of each group and the reason for setting it up will be attempted before undertaking a more detailed analysis of the individual electrode types available in each.

*Group A—Low Alloy.*—Many experts in the hard surfacing business feel that all electrodes containing less than 20% of alloys should be considered together. Here all combinations of analyses from intermediate carbon unalloyed steel to those containing substantial amounts of chromium, manganese, silicon, nickel, molybdenum and other elements will be found.

*Group B—Manganese Steel.*—Despite the fact that manganese steel electrodes contain less than 20% of alloying elements it is felt that this group has enough distinctive characteristics to warrant separate treatment. Fundamentally it is often less hard than its other low-alloy cousins but this condition is more than offset by the work-hardening properties of the deposited metal.

*Group C—High Alloy, Ferrous.*—Electrodes in this division contain more than 20% of alloys with combinations running slightly over 50%. Essentially this group combines certain corrosion-resisting attributes with good performance at elevated temperatures where the low alloy-types are liable to lose their hardness.

*Group D—High Alloy, Nonferrous.*—Using alloys such as cobalt and tungsten in addition to the universal ingredient in almost all hard surfacing electrodes, chromium, this branch of the hard-facing tree exhibits excellent resistance to wear along with outstanding performance at elevated temperatures. It, too, has good properties and is available in many analyses that give a substantial range in strength and toughness.

*Group E—Carbides, etc.*—This classification includes the heterogeneous or composite electrodes which are essentially tubes filled with crushed tungsten carbides. Varieties of services are satisfied by filling the tubes with carefully selected sizes of crushed carbides so that the resulting deposit consists of a steel matrix in which the wear-resisting tungsten carbides are imbedded.

*Group F—Bronzes.*—Bearings and similar parts subjected to sliding or rotating friction may be overlayed with aluminum or similar bronzes which provide an ideal bearing surface. Several analyses are available with a good spread in hardness and other desirable traits such as strength and toughness.

At this point a short digression appears to be in order. Welding has achieved a definite stature as a science rather than an art. In the common grades of mild steel, low-alloy and stainless steels almost every user of welding is familiar with the various types of electrodes available and the most logical weldments for each. But no such easy knowledge of the hard surfacing electrodes has been reached. Some rather large users of hard surfacing are but vaguely aware of the correct application of the different groups, or for that matter of the conditions and compositions in which he ought to be vitally interested. To prove this point, consider the fact that one of the largest governmental users of welding specifies hardness alone and frequently awards contract to a low bidder who furnishes an unalloyed product. Likewise a large railroad follows a similar policy even going so far as to stipulate the carbon analysis of the core wire even though this has little bearing on the wear-resistant properties of the finished weld. Chromium, not carbon, is the principal element employed for wear resistance. To prove this point the wear resistance of Group A weld deposits containing chromium is about three times that of weld metal of similar hardness but unalloyed. When it is recalled that the cost of the chromium containing welding electrodes is often only slightly more than the plain high-carbon types, there is even less reason for choosing an unalloyed material. But add the extra labor cost involved in a more frequent replacement of the straight carbon deposits and it becomes quite clear that the purchase of the latter type may prove to be a false economy.

Manganese imparts abrasion-resisting properties to steel and the selection of a straight carbon steel hard surfacing electrode with appreciable manganese serves well in chutes and similar products where increased resistance to simple abrasion is desired. However, some fabricators prefer chromium and manganese for these applications feeling that the somewhat greater expense is more than justified by the improved performance of their product.

Thus we find the following typical analyses of core wire and weld deposits in rather widespread use:

| | C | Mn | P | S | Si | Cr |
|---|---|---|---|---|---|---|
| Core wire | 0.10 | 0.50 | 0.03 | 0.04 | 0.02 | .. |
| Core wire | 1.00 | 0.95 | 0.03 | 0.04 | 0.10 | .. |
| Deposit | 0.50 | 1.30 | 0.03 | 0.04 | 0.20 | .. |
| Deposit | 1.00 | 2.50 | 0.03 | 0.04 | 0.20 | .. |
| Deposit | 0.20 | 1.50 | 0.03 | 0.04 | 0.65 | 0.65 |
| Deposit | 0.55 | 1.75 | 0.03 | 0.04 | 0.90 | 2.60 |

These are the common mild steel and low-alloy types used for a multitude of wear-resistance applications. It will be seen that the chromium alloyed analyses achieve their hardness with less carbon than is the case with the unalloyed varieties. Frequently the chromium-bearing varieties yield a sounder deposit with less welder manipulation than is the case for the plain-carbon analyses.

Several fundamental metallurgical considerations should be kept in mind when applying hard surfacing electrodes of Group A. Welding for wear resistance is closely akin to heat treating and some of the same considerations are applicable. A small electrode will produce a harder deposit than a large electrode when welding on a piece of fixed dimensions. The smaller electrode has a lessened self-tempering effect. On a small piece the beginning of the weld may be harder than the end of the weld. Wide beads will be softer than narrow beads. Preheating will lower the hardness of the deposit as the following table shows:

| | Rockwell C | Brinell |
|---|---|---|
| No preheat | 54–62 | 540–653 |
| Preheated 600° F. | 33–37 | 315–352 |

This result was obtained with electrodes of the following analysis: C 0.35, Mn 1.78, P 0.04, S 0.02, Si 0.09 and Cr 2.90 when deposited on used 130-lb. rail of this analysis: C 0.71, Mn 0.78, P 0.011, S 0.020 and Si 0.16.

Improved wear resistance may be obtained through the intelligent combination of welding procedure and heat treatment. Hard surfacing electrodes are often alloyed to get a specific adequate hardness in the as-welded state. But sometimes it is desired to machine after welding. To do so the part is first annealed and then machined. Finally the finished part is heat treated. Water or oil quenches have been used successfully in addition to flame hardening and hardening by induction heating.

Another factor must be kept in mind. When welding on high-carbon steel, some preheat may be desired to avoid cracking of the base metal. Also high-carbon base metal will affect the hardness of the deposit depending upon the amount of dilution resulting from penetration of the base metal. The amount of build-up will influence the final hardness as several layers may be softer than but one layer or a thicker layer may be softer than a thinner one because of greater heat input and slower cooling rate.

## Should Give Smooth Deposits

Hard surfacing electrodes are used for chisels, punches and dies and typical analyses are shown in Table 4. Often the wire used for electrode cores approximates the analysis of the tool steel to be duplicated with suitable adjustments to the coating to add elements lost in arc transfer or most efficiently added through the coating.

Electrodes of the hard-facing types ought to give very smooth deposits requiring a very minimum of dressing to final size. They should deposit sound welds although some brands will call for a certain amount of arc manipulation to free the deposit of surface pits. Often a slightly longer arc will do. And the slag should come free with very little effort.

Electrodes are currently available for both d.-c. and a.-c. application. With direct current some types of coating perform best with straight polarity while others, need reverse polarity. Manufacturers' recommendations should be followed in this regard. Coatings should be nonconductive although one brand fails to meet this requirement which is not objectionable on flat work in the open. There is a vast difference in ease of application among a number of brands which suggests the value of experimentation to select the best electrode for each individual application.

Sometimes when difficulty is encountered welding over steel that has previously been hard surfaced, an intermediate deposit of stainless steel is very helpful. This application is quite similar to the frequent practice of depositing stainless steel (18–8) prior to the deposition of manganese steel.

Manganese steel electrodes have been given a separate classification because they represent a specialized type of welding material. Austenitic manganese steel has long been established as an outstanding analysis for railroad frogs and crossings. Such special trackwork is costly and difficult to replace without undue traffic interruptions. It was logical, therefore, that an electrode of similar analysis should be developed for hard facing these tailor-made track-work installations.

Other manganese steel is rebuilt similarly and crushers, grinders and a host of similar machines are being restored to service with manganese steel weld metal. Sometimes manganese steel inserts are welded in place with manganese steel electrodes to reduce the amount of welding required.

For most successful work a short arc is maintained and the electrode is oscillated in order to deposit as wide a bead as is practicable. A circular motion is used with hesitation along the side of the bead to prevent the formation of pits. Good technique yields a remarkably smooth deposit that requires little grinding. Each layer is peened to prevent cracks and to raise the hardness as manganese steel in its original deposited state is relatively soft. Peening during welding and work hardening due to use soon raise the hardness to a good working value.

## Use of Bare Electrodes

A long arc at the beginning and end of the bead permit the establishment of a sound layer without either pits or blisters which are always indices of incorrect welding procedure. Bare electrodes are used with direct current, reverse polarity, while coated electrodes are used with direct current, either polarity but following manufacturers' recommendations as coating compositions differ, or alternating current. Bare electrodes build up the higher deposit but require more skill in application while coated electrodes may be used where less metal is needed and where the usual advantages of easier handling are important.

The third group of hard-facing electrodes is the high-alloy ferrous family. In addition to the regular standby, chromium, will be found appreciable amounts of manganese, silicon, cobalt, vanadium, nickel, tungsten, boron and titanium. Not all of these elements will be found in any one electrode but various groupings for particular service response are available.

Electrodes of this type are more resistant to corrosion than the lesser alloyed groups but are not the best choice where a very corrosive environment is encountered. Little impact resistance will be found in this classification pointing to the necessity of good base metal support or the choice of Group A if impact must be resisted. No heat treatment can be employed with deposits from these electrodes so that grinding rather than machining is the rule. A smooth, highly polished surface can be developed.

Group D, the fourth group to be reviewed, is a non-ferrous classification with some unusual properties. Usually its deposits are quite resistant to corrosion being equal to or better than austenitic stainless steel in this

**Table 4—Analyses of Group A Weld Deposits for Specific Uses**

| Use | C | Mn | P | S | Si | Cr | W | V | Mo |
|---|---|---|---|---|---|---|---|---|---|
| Chisels, punches | 0.80 | 0.70 | 0.03 | 0.04 | 1.30 | ... | ... | .. | .. |
| Oil hardening, nondeforming die steel | 1.00 | 1.20 | 0.03 | 0.04 | 0.30 | 0.50 | 1.00 | 0.30 | .. |
| High-carbon, high-chromium die steel | 2.30 | 0.50 | 0.03 | 0.04 | 0.20 | 13.00 | ... | .. | 0.50 |
| Hot work steel, tungsten type | 0.30 | 0.30 | 0.03 | 0.04 | 0.20 | 4.00 | 14.00 | 0.50 | .. |

regard. Also weld metal in this group possesses excellent heat resistance making it applicable to services where high temperature and corrosion are found as in high-pressure, high-temperature power plant and refinery services. Some of the softer alloys may be machined with carbide tools while the harder alloys are non-machinable. The softer alloys, as would be expected, possess rather good impact strength with the harder alloys having little impact resistance.

### Additional Hard-Surfacing Types

The fifth group, Group E, consists of tunes of varying diameters and rather short lengths filled with crushed tungsten carbides. Different screen sizes are available to make certain that undissolved tungsten carbides will be found in the steel matrix of the deposit.

Good impact resistance is imparted by the soft matrix, Deposits may not be machined but must be ground to size. Diamond wheels are used. The matrix may be heat treated. In services for which Group E electrodes are suited, their deposits will give the best wear resistance known.

The last group of hard surfacing electrodes is unique in that it may be applied to a wide variety of metals such as steel, cast iron, bronzes, nickel alloys and various alloy steels. Of course, this range is due to the copper base of the weld deposit. Aluminum bronzes are the most frequently encountered types.

Hardnesses vary from 100 to nearly 400 Brinell with wear resistance and hardness being controlled by increasing the proportions of aluminum and iron in the deposit. Facings are used for bearings, gears, bushings, slides operating against hardened steel under high pressure, cams and drawing dies.

Direct current, reverse polarity is recommended for these electrodes with a short arc giving the best welds. A rapid weaving motion is desirable as the large globules transferring from the end of the rod might otherwise cause excessive sticking of the electrode to the work. Weaving is usually three to four times the diameter of the electrode.

Large-size electrodes yield the most economical deposits. Besides they can be used with a lower current density thereby melting less of the base metal. X-ray results are good when moisture is avoided and meticulous care is specified in removing the slag before depositing additional layers.

Coating materials include sodium fluoride, cryolite and sodium silicate among others. Sodium fluoride, like the calcium fluoride used in stainless steel coatings, suggests the need for adequate ventilation to remove the fumes which are objectionable.

Summing up, it may be advisable to report on relative attributes of the various groups outlined. Of course, specific service conditions may alter some of these arrangements but in general they are correct. In each grouping the types will be listed in order of their response to the attribute covered.

*Hardness:* Group E, Group C, Group A, Group D, Group B and Group F.

*Wear Resistance:* Group C, Group D, Group B, Group A and Group F.

*Corrosion Resistance:* Group D, Group F, Group C, Group B, Group A and Group E.

*Impact Resistance:* Group B, Group A, Group F, Group D, Group E and Group C.

Perhaps not too much importance can be attached to the relative popularity of the various types of hard surfacing electrodes. Still the experience of one manufacturer of Group A, Group C and Group E metallic arc electrodes shows the following distribution of types in a list of several hundred specific applications:

| Type | No. of Applications |
|---|---|
| Group A | 149 |
| Group C | 81 |
| Group E | 19 |

Suggested welding currents and voltages have not been reported because of the wide diversity of types covered. Manufacturers' literature may be consulted for these figures remembering that lower currents and shorter arcs prevail for conservation of alloys while arc length must be great enough to get a smooth, clean deposit.

Response to atmospheric moisture cannot be treated again because of the many variables. Once more it should be mentioned that all electrodes gain moisture from the surrounding atmosphere indicating the desirability of cool, dry storage wherever possible. Fortunately all mineral coatings prevail almost without exception which means that overdrying is unlikely. From 200 to 300° F. for at least 1 hr. ought to dry any electrodes that require drying.

No hard and fast rules prevail in the hard-facing field. The manner in which hardness is attained and not specific hardness is the best criterion. Usually alloys, particularly chromium, which form hard, wear-resistant carbides are desirable. No more expensive material than is demanded for the application should be sought. On the other hand, cheapness ought not to be regarded too highly as engineering rather than cost factors should determine the type. Perhaps 60% of all applications can be satisfied with Group A materials. Wherever repeated surfacing is done, experimentation on the part of the consumer will prove profitable. For hard facing is similar to taking medicine. A specific prescription is needed for each ailment and it is most unlikely that a single elixir or electrode will cure all ills.

## Part III—Cast-Iron Electrodes

ONE of the more difficult fields of metallic arc welding is that of cast iron. Whereas the excellent balance of mechanical properties in steel makes the welding of this material almost foolproof, the poor ductility of cast iron makes the average welding engineer approach such jobs with considerable caution. However, when the peculiarities of cast-iron welding are kept in mind, there are several welding methods that will lead to good welded joints.

Before undertaking a description of the five groups of cast-iron electrodes, a short discussion of the chemical, physical and metallurgical make-up of cast iron ought to be profitable. Primary chemical constituents of cast iron, other than the iron itself, are carbon which

ranges from 2 to 4% and silicon which runs from 0.50 to 3%. Keeping in mind the influence of carbon on the welding of steels, it is quite apparent that the very high carbon content of cast iron will cause some metallurgical problems.

Strengths of cast irons may be as low as 20,000 psi. or may run up to 60,000 or more. Foundrymen are incorporating many innovations in cupola practice which are bringing a fair degree of ductility to their irons along with strengths that are going far to free cast iron of the limiting engineering restrictions that have prevailed heretofore. This discussion, in order to add a margin of safety, will discuss methods and procedures involved in the welding of ordinary gray iron with the understanding that these same practices may be carried over into the welding of the newer irons and semisteels. Therefore, cast iron will be classified as a material possessing poor ductility.

The metallurgical structure of cast iron is usually pearlite with free flakes of graphite representing the excess carbon over that necessary to a pearlitic structure. Or the matrix of cast iron might be ferrite with excess graphite—this is not a common structure for modern cast irons.

Above 1300° F. the combined carbon in the pearlitic matrix breaks down to ferrite and graphite with some change in volume and a decided loss of strength. Near the melting point carbon is reabsorbed. Cooling of welds and the adjacent affected metal frequently leads to the formation of hard and brittle structures because of the high carbon content of the material involved. For several reasons, therefore, preheating and slow cooling are vital considerations in the welding of cast iron; namely: (1) to control the volume changes in a metal of limited ductility; (2) to slow the cooling rate to avoid the formation of hard and brittle combinations of iron and carbon; and (3) to provide a measure of stress relief in order to avoid overstressing a material unable to stretch to iron out differences in stress.

Five distinct types of metallic arc electrodes are available for the welding of cast iron. As shown in Table 5 these electrodes are cataloged according to the type of core wire employed in their manufacture. Of course this type of identification applies equally well to the kind of deposit which is, after all, a direct function of the core analysis. So cast-iron electrodes contain one of the following cores: low-carbon steel, cast iron, Monel or nickel, copper alloy or a composite wire generally built up of steel, copper and nickel. The cast-iron electrodes will be reviewed individually.

Cast-iron electrodes with a mild steel core wire are most common, but this does not mean that they are the best. Rather the best iron electrode is the one that furnishes the most suitable properties for the application at the lowest cost.

This group of electrodes looks like any other common steel metallic arc electrode. It is heavily fluxed with a coating designed to give outstanding arc stability with the extremely low currents desired for cast-iron welding.

**Table 5—Types of Cast-Iron Metallic Arc-Welding Electrodes**

| | |
|---|---|
| Group A | Low-carbon steel core |
| Group B | Cast-iron core |
| Group C | Monel or nickel core |
| Group D | Copper alloy core |
| Group E | Composite core |

Likewise the coating has a low melting temperature to further aid in the use of low current values. Slag formed from this coating is readily removed from the weld deposit. And the weld metal produced is both smooth and uniform in contour to provide an even union of the weld metal and parent metal without any abrupt change in section at the fusion line as might be found with an uncoated electrode.

**Table 6—Current and Voltage Ranges for Group A Electrode Applications**

| Size of Electrode, In. | Recommended Amperes | Recommended Volts |
|---|---|---|
| 3/32 | 60–95 | 19–23 |
| 1/8 | 80–110 | 20–24 |
| 5/32 | 110–150 | 21–25 |
| 3/16 | 130–180 | 22–26 |

Since the weld metal formed by electrodes of this type is essentially steel, it is not surprising that a rather high-carbon steel results because of the carbon dissolved out of the cast iron when filler metal and parent metal mix in the fusion area. Cooling rates are generally such as to form a hard weld deposit and a hard heat-affected zone both of which mean that welds made from electrodes using a steel core are unmachinable.

Because steel does not match cast iron in appearance, deposits from this group of electrodes will not match the color of cast iron. As a matter of fact this same statement may be made of four of the five electrodes as only one classification uses a cast-iron core and produces a metal similar to that being welded. The steel deposit is stronger than the cast iron and fuses well with it. Because of the low currents permitted by the stable coating, heat-affected zones are of minimum thickness.

## Surface Should Be Clean

Alternating current and direct current, either polarity, is suitable. Here, too, manufacturers' recommendations must be followed if best results are to be obtained. There is some difference of opinion among the advocates of straight and reverse polarity when direct current is used. Some engineers feel the lesser penetration of straight polarity is desirable while others maintain that deeper penetration is essential to satisfactory fusion. As is often the case, good welds are made under either condition.

Since the heat input in cast-iron welding is best held to the lowest possible value, Group A electrodes are available in small diameters only. Some manufactures make the 1/8 in. diameter only while others make sizes from 3/32 to 3/16 in., inclusive. Suggested current ranges and correct voltage ranges are given in Table 6.

As is common to practically all fusion welding applications, the surface to be welded should be clean. Any oil or grease should be removed either chemically or by burning away with a flame. If the welding is being done to repair a crack, the crack should be thoroughly chipped or ground out leaving a groove for the weld metal. Sometimes a small hole is drilled just beyond either extremity of the crack to prevent further propagation It is advisable to make sure that all of the crack has been removed by checking with magnaflux or a penetrating oil and whitewash before starting in to weld. Studding has been a common practice in large repairs.

Usually Group A electrodes are used with a "cold" welding technique. No more current is used than is necessary to the deposition of a smooth, well-fused bead. Short bead increments are best with no bead running more than 3 in. in length. Skip welding is suggested to keep the parent metal cold. Curved, rather than straight continuous beads, are best. Each bead should be lightly peened while it is still hot.

Some electrodes in this group are more affected by atmospheric humidity than others but a cool, dry storage space ought to keep the coating in prime condition. Extremes of temperature should be prevented. Fresh electrodes give the best performance and it is suggested that inventories keep pace with use. A softened coating may indicate excess moisture.

Although the majority of Group A electrodes deposit a steel weld metal, there is one variety that produces a cast-iron deposit because of coating additions. This coating is largely graphite with a small amount of barium carbonate and the rest carborundum with all ingredients bound together and to the core with the usual silicate binder solutions.

There are many applications of Group A electrodes for welding cast iron with a partial list covering cylinder blocks, cylinder heads, bearing blocks, machine parts, large frames, machine bases, cast boiler sections, headers, cast-iron wheels, Diesel water jackets, tractor transmission cases, tractor differentials, compressor blocks, steam radiator sections, gear teeth, welding cast iron to steel, lamp posts, fire plugs, pulleys, wheels, casting repairs such as blowholes, sand cavities, etc., printing press and drying rolls and valves.

Group B electrodes are those with the coating surrounding a cast-iron core. There are several analyses of core wire used and the analysis establishes the preheating phase of the welding technique. One group of analyses requires a preheat of 1000° F. in order to make a machinable weld in cast iron while the other group has a chemistry balanced to permit good machinable welds with a preheat temperature of only 300° F. Manufacturers' recommendations will furnish a clue to the type of analysis employed.

Deposited weld metal from Group B electrodes is a fine-grained cast iron. It is free of porosity with a hardness of 15 to 20 Rockwell C or 87 to 97 Rockwell B. The heat-affected zone should be as machinable as the deposit.

As was the case with Group A electrodes, the casting should be cleaned prior to welding. Grinding is suggested and a vee of 60 to 90° included angle is best suited to the application of the cast-iron weld metal. Next the portion to be welded is preheated to 300° F. And finally the weld is made with $^1/_8$-in. electrodes at 150 to 175 amp. using direct current, reverse polarity. With this electrode best results will be had if the welding is done hot with but slight delay between the deposition of successive layers.

## Group B Welds Light, Heavy Castings

Both light and heavy castings may be welded with Group B electrodes. Should a light section be joined to a heavy section, it is advisable to put most of the preheating work on the heavy section. This will prevent cracking of the heavier section which because of the mass cooling action associated with heavy metal structures might otherwise cool too rapidly. Welds of Group B classification may be machined at surface speeds up to 65 ft. per minute if the welding has been correctly accomplished.

The most common constituents of the coatings on cast-iron electrodes are graphite and silicon with a minor amount of slag formers and all of these materials held together with a suitable silicate binder which also anchors the coating to the core. Both the graphite and silicon, although a number of other elements such as phosphorus, titanium and copper perform similarly, serve to produce a gray iron. Graphite permits a higher arc temperature while the silicon produces a metal with a lower melting point. In combination the graphite-silicon coating yields an extremely fluid weld metal and permits effective inoculation, despite the short time in which the metal is fluid, to provide nuclei for the carbon to precipitate as graphite.

It is the graphitic carbon and the all-around balance of deposit chemistry that has enabled the electrode maker to furnish a good Group B electrode with a weld metal that matches the color and behavior of gray iron quite closely. Alloys may be added to control the tensile strength which can reach 50,000 psi. with a Brinell hardness of 275 which is definitely machinable.

Group C electrodes made with a Monel or nickel core were the first machinable electrodes available for the welding of cast iron. At first the usual enthusiastic claims about producing a machinable weld without preheat were made but later experience has indicated that some welds need preheat although quite a number are made with little or no preheat. When no preheating is used, there is liable to be a hard martensitic zone in the heat-affected region which will defy machining. A 500° F. preheat suffices to prevent martensitic formations.

Heavily coated electrodes in diameters from $^3/_{32}$ to $^3/_{16}$ in., inclusive, are used with the welding currents set forth in Table 7. Again specific values should be based on manufacturers' recommendations for each electrode being used. As is true of all cast-iron welding, the smallest electrode size should be used to prevent overheating of the base casting. Heavier castings and preheat permit the selection of larger electrodes. Once more there are differences among the several electrodes available in the Group C classification with all of the performing satisfactorily with alternating and direct current. With direct current, however, some makes give the best arc action with reverse polarity while others require straight polarity.

## Wide Distribution of Arc Weld Heat

When using Group C electrodes without preheat, it is suggested that the heat of arc welding be distributed as widely as possible to avoid local hot spots. Such a technique avoids undesirable steep temperature gradients and intense stress concentrations either of which will crack the casting.

No more current than is needed to fuse the weld metal with the casting ought to be used. Small diameter electrodes and small beads of narrow width and no more than $2^1/_2$ in. long have proved to be the best. Peening immediately after breaking the arc will relieve stresses. After each short welding campaign, the casting must be allowed to cool to hand warmth before proceeding with additional welding. If the casting is too hot to the touch, additional cooling time is indicated.

If preheating is used with Group C electrodes, a temperature of 500° F. appears to give the best welding condition and this temperature must be maintained throughout the entire welding period. Otherwise welding technique is little different from that outlined for welding without preheat. Narrow beads can be placed at the

**Table 7—Current Ranges for Group C Electrode Applications**

| Size of Electrode, In. | Recommended Amperes |
|---|---|
| $^3/_{32}$ | 60–80 |
| $^1/_8$ | 80–100 |
| $^5/_{32}$ | 120–180 |
| $^3/_{16}$ | 180–250 |

bottom of the vee with narrow overlapping beads along either side. Since Group C electrodes are considerably more expensive than Group A electrodes, economy suggests facing the vee with Group C deposit. Then fill the groove, of course this combination filler metal plan applies primarily to large welds, with Group A weld metal. Finally make the last two passes with Group C metal to provide machinability. Beads are placed alternatively on one side and then the other of the groove to minimize stress build-up. And the casting is often covered with powdered asbestos, lime for fine ashes to allow very slow cooling to ambient temperatures. This latter precaution is known as crack insurance.

Experience is the best teacher as to whether or not preheating is needed. If a rigid joint in a small casting of thin section is to be made, preheating is virtually a *must*. If a light, casting is broken in two (and thus is free to move), preheating is unnecessary. If a watertight weld is demanded, preheating ought to be specified. On the other hand welds in heavy castings and in good positions have been made without preheating. It is suggested that the novice preheat and the question of whether or not to preheat can be resolved as experience is gained.

Brinell hardness of the deposit is about 220. It is suggested by one manufacturer that machining be done across the weld.

Group C electrodes have worked well in the following applications: casting repairs, correcting machining errors, filling sand pockets, filling drill holes, auto cylinder blocks, auto cylinder heads, cylinder wall defects, impeller rings, valve seats, motor exhaust ports, gears, sprockets, cast-iron dies, pulleys and wheels.

### Surface Preparation Important

Group D electrodes have copper alloy cores and are either phosphor bronze or aluminum bronze in the most popular brands. Because the melting point of cast iron is only slightly above that of the bronze filler metal and because the inclusion of iron in the bronze weld metal is highly undesirable, the lowest possible currents consistent with good tinning give the best welds. Tinning the side walls of a groove followed by welding to fill in the groove without penetrating the tinned overlay is very satisfactory.

Surface preparation must be emphasized once more and this time a rather detailed treatment will be undertaken. The surface to be welded should be free of grease or rust. Frequently machining or grinding operations prepare the surface but in so doing leave a film of graphite on the metal. Graphite seriously interferes with the deposition of bronze and must be removed. Sand blasting is the ideal method although rough chipping or searing with an oxyacetylene flame will give satisfactory surfaces.

**Table 8—Current and Voltage Ranges for Group D Electrode Applications**

| Size of Electrode, In. | Recommended Amperes | Recommended Volts |
|---|---|---|
| 1/8 | 80–100 | 25–28 |
| 5/32 | 110–130 | 25–28 |
| 3/16 | 130–160 | 27–30 |

Searing is accomplished by adjusting the flame with an excess of oxygen which serves to burn up the carbon film. The torch is passed back and forth over the iron, holding the white tip of the flame close to the metal, until incandescent particles indicate that the carbon is being consumed. Rapid enough traverse of the torch to avoid melting the iron is desirable but the speed should not be too fast or the graphite will not be completely burned away from the surface.

Since preheating is required for the best deposition of bronze weld metal on cast iron, the searing operation will often do the desired preheating at the same time.

Otherwise preheating to a temperature of 200 to 300° F. prior to welding must be made a separate operation. Overheating is harmful and a maximum preheating limit of 400° should be observed. Higher temperatures lead to melting of the cast-iron surface during welding and may result in forming a "hot short" weld deposit.

One proved technique with bronze filler metal is a wide oscillation of the electrode, using the electrical conditions set forth in Table 8 ,to which a short oscillation of travel is added. This is accompanied by a shortening of the arc to actually wipe the weld metal off on the deposit rather than waiting for the customary large drop to form and drop off on the work. The purpose of this technique is to bring about a steady deposition of bronze without allowing much time for the arc to play on the cast iron as this would melt the surface of the iron which is undesirable.

Group E electrodes are composite core materials with the core of steel sheathed with copper, nickel sheathed with copper or steel sheathed with nickel and copper. The second named combination, nickel sheathed with copper, performs similarly to Group C electrodes and no further instructions or suggestions are necessary.

Group D electrodes, with suitable precaution, will weld cast iron to other metals.

Cast-iron welding by the metallic arc process is quite successful. It is necessary to remember, however, that cast iron is not a ductile material such as steel. This means that thermal shock is to be avoided to prevent cracking which is the worst bugaboo of cast-iron welding work. Preheating and postheating do much to avoid cracking and slow cooling in several insulating materials has been specified with considerable success. As long as the job is well planned and executed with good materials, there is every change of success.

# Fabrication and Reclamation in Steel Mill Maintenance*

By E. W. Gruber

THE functions and assignments of the welding department in a steel mill are by no means uniform between one mill and another. In one mill the welding department may be called upon to perform only the minimum functions necessary to keep mill equipment in operating condition; in others these duties have been expanded during wartime to include the fabrication of certain replacement parts which are unobtainable due to the war; in still others this department is regarded as the means of making the mill almost self-sufficient in providing for all repair, reclamation, replacement and original construction needs. It is this last type of organization that I wish to describe in this paper.

We need not go back very far to find the time when welding was strictly a repair tool, and we have all witnessed or taken part in the growth of welding, both in the improvement in the apparatus and techniques employed, and in the scope of its applications. This development has been so rapid, however, that sometimes our own conception of how we can adapt welding to our own routine and emergency needs falls behind.

The growth of the maintenance department at the Yorkville Plant of Wheeling Steel Corp. has been characterized by an attitude of comparing what is being done with what could be done. In fostering this development we were fortunate in having an aggressive maintenance foreman whose approach to almost any problem was along the lines of, "I don't care how you handled this job before. We can do it better by welding." Over a period of time the maintenance department has gradually assumed more and more duties until now, whenever a need for anything arises or is foreseen in any other department, it is almost axiomatic that the welding crew is called in and given first crack at it. Usually they need go no farther.

* Presented at the Twenty-Fifth Annual Meeting, A. W. S., Cleveland, Ohio, Oct. 16 to 19, 1944.

† Plant Engineer, Wheeling Steel Corp., Yorkville, Ohio.

The reasoning behind this is, we believe, entirely sound from several standpoints. First, of course, any steel mill must have a maintenance organization capable of dealing with any emergency problem such as breakdown of primary mill equipment. In addition to this function, however, it is highly desirable, due to the nature and amount of equipment in a mill, to have this organization sufficiently equipped with skilled operators, apparatus and ingenuity to enable them promptly to repair or replace any secondary plant installation which breaks or wears out. Finally, this department is used for a wide variety of new construction work, in which welded fabrication is employed wherever possible.

It might seem from the foregoing that to fulfill all these duties a large welding department would be needed, and that the economies which might otherwise be effected by doing our own work instead of making outside purchases would be reduced or wiped out by the cost of maintaining the department. Our own experience shows that this need not be true. We operate with a staff of only eight welders and two helpers, which is certainly not large for a steel mill maintenance department, and is actually no more than the minimum needed in a mill of this size to cope with all urgent repair and plant maintenance work. Yet by planning the work we are able to handle a constant stream of special fabrication jobs in odd hours between regular reclamation and repair work. For example, a fairly large capacity oil-reclaiming installation, including an oil-warming tank, sampling tank, two storage tanks, and auxiliary equipment, was fabricated during spare hours over a period of several weeks.

An unusually interesting example of the fabrication work of this department is the construction by low-temperature brazing of copper conductor rolls for an electrolytic tinning mill. We were in urgent need of spare rolls, and as our supplier was unable to make prompt deliveries our welding department went to work on this problem. These rolls have lead washer seals between the heads and the shaft to prevent leakage of

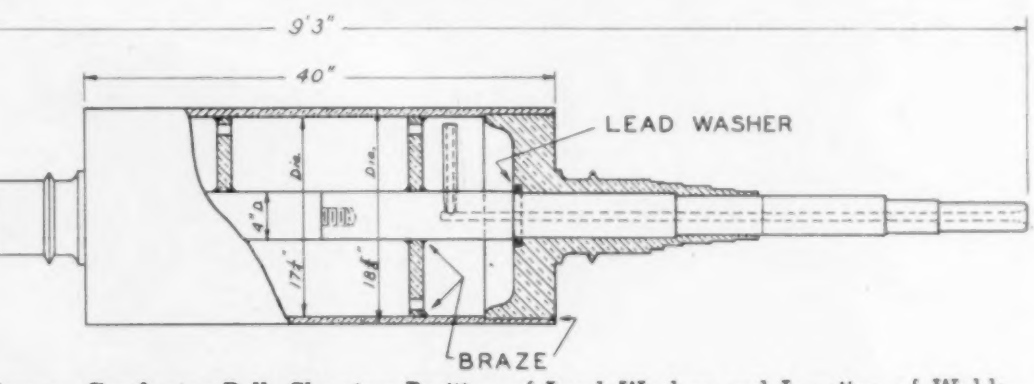



Fig. 1—Fabricated Copper Conductor Roll, Showing Position of Lead Washer and Location of Welds. All Joints Were Made by Low-Temperature Brazing

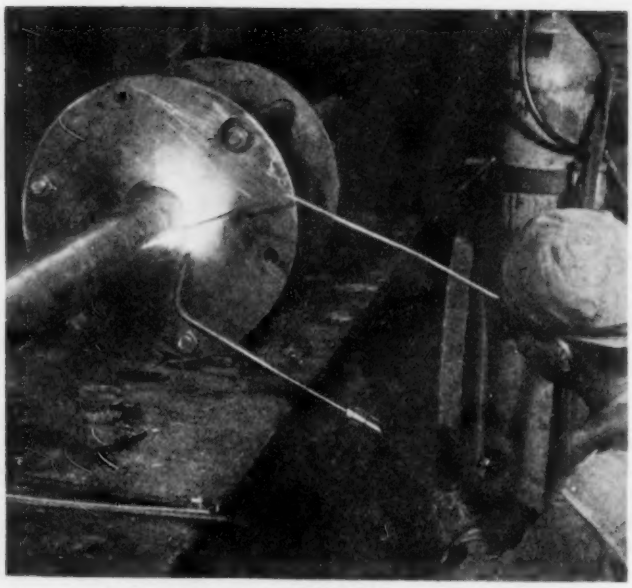


Fig. 2—Brazing Baffle Disk to Shaft of Copper Conductor Roll. Preheat Burners Are Not Shown Here

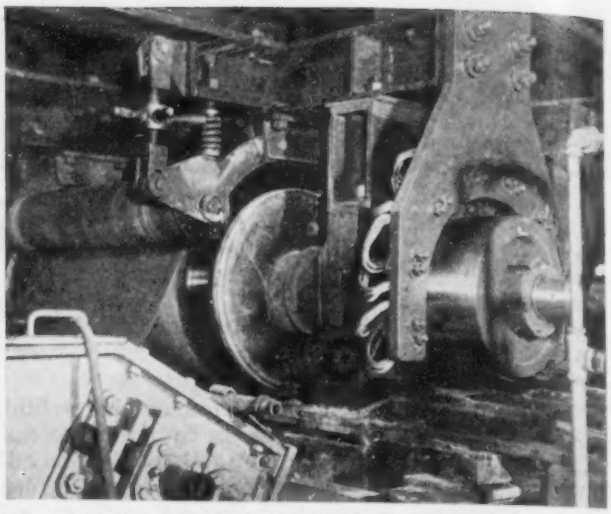


Fig. 4—Close-up of Fabricated Copper Conductor Roll Installed in Electrolytic Tinning Mill. This Roll Eliminated Trouble Previously Encountered Through Clogged Water Outlets and Overheated Rolls

the internal cooling water, and one of the chief problems in welding was to make certain braze welds without melting the lead washers. If any of the lead melts it remains in pellet form within the hollow roll. These pellets roam around and become worn to a size where ultimately they clog the circulating water outlet, causing the roll to become overheated by the heavy electric current.

As indicated by the diagram in Fig. 1, this roll is made up principally of an outer shell, two web disks, two heads and a shaft. The shell and disks are copper, and the heads cast bronze. In fabricating these rolls, considerable trouble was at first encountered in drilling the long holes in the shaft. This was finally overcome by grinding the drill slightly off center and using carbon oil as a lubricant. The two webs were then roughed to size and the center hole bored 0.001 in. smaller than the shaft diameter. They were then shrunk on the shaft and the silver brazing was begun, as in Fig. 2.

The high heat conductivity of the copper presented an obstacle in brazing, despite the fact that we were using Sil-Fos, a low-temperature brazing alloy. We first tried preheating the entire assembly to a soaking black-red heat in a furnace, then brazing with an oxyacetylene torch and No. 12 tip. However, the heat carried away too fast to permit the alloy to flow. To insure sufficient heat at the point of brazing we then played two natural gas and compressed air burners directly on the shaft, until the baffle became light red. The burners were shut off and two welders with No. 12 tips then brazed one-third of the circumference of the joint. The same cycle was repeated twice to complete the brazing of one baffle to the shaft. The second baffle was brazed in the same way, using $^3/_{16}$-in. Sil-Fos rod. The shaft assembly was trued up on a lathe and the outside rim of the baffles turned to a diameter 0.003 in. larger than the inside bore of the outer shell.

After the shell had been bored to a 0.004-in. press fit for the cast-bronze heads or hubs, it was heated to about 400° F. and the shaft assembly was shrunk into it in a vertical jig. Brazing of the shell to the baffles required

Fig. 3—Completed Roll, Fabricated by Low-Temperature Brazing at a Considerable Saving in Cost

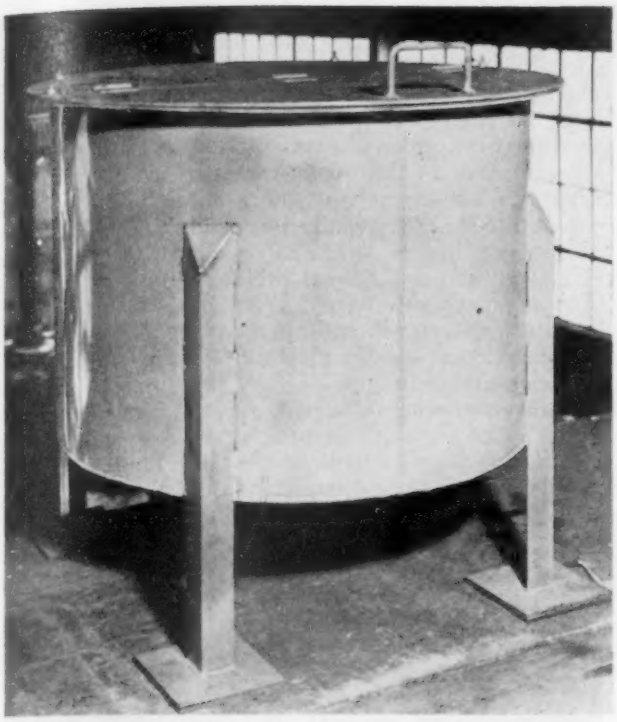


Fig. 5—This Fabricated Steel Tank Is One Unit of a Complete Installation for Reclaiming Contaminated Oil. Steam Pipes Coiled Inside Heat the Oil in the First Stage of Reclamation

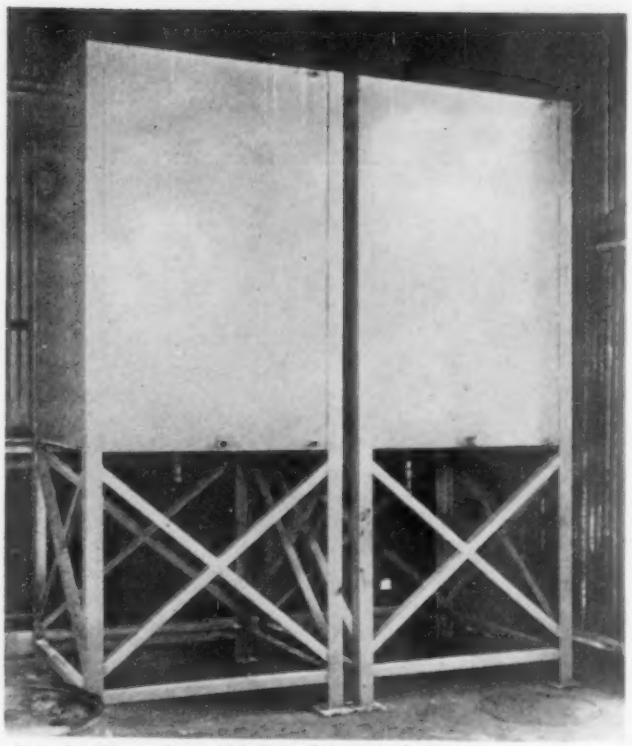


Fig. 7—These Two 600-Gal. Fabricated Storage Tanks Hold Reclaimed Oil for Re-use. Entire Oil-Reclaiming Equipment Was Fabricated by the Mill Maintenance Department

supplementary heat by the burners as well as the two large-size oxyacetylene torches, to overcome the rapid dissipation of heat by the copper.

The two bronze heads with preplaced lead washers were then pressed into position, thus compressing the lead around the shaft. The entire assembly was hung vertically for the critical operation of brazing the ends to the shell without melting the lead. To accomplish this, brazing was done with a carbon arc to provide a high, localized heat. Sil-Fos was run into the prepared V groove by applying heat in increments so that at no time did the temperature of the head rise to the melting point of the lead seal. This procedure also prevented warping of the shell. After completion of brazing, the roll was machined down to finish size, ground, chrome plated and finally reground, appearing as in Fig. 3. The roll installed is shown in Fig. 4.

## Oil-Reclaiming Equipment

The amount of lubricating oil needed to keep a mill running is quite large, representing a fairly important item of expense if the oil is used only until contaminated and then discarded. Oil is, however, practically indestructible and can be used over and over again if

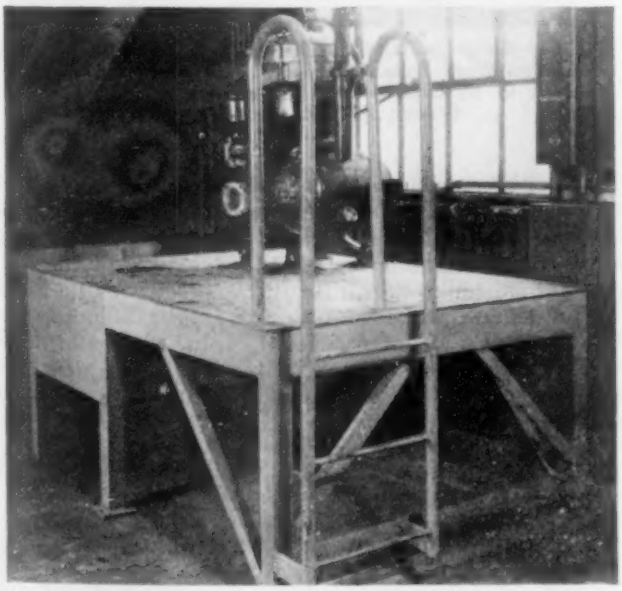


Fig. 6—Centrifuge Platform, Fabricated of 1/4-In. Steel, for Removing Water from Oil. Temporary Reservoir Beneath Platform

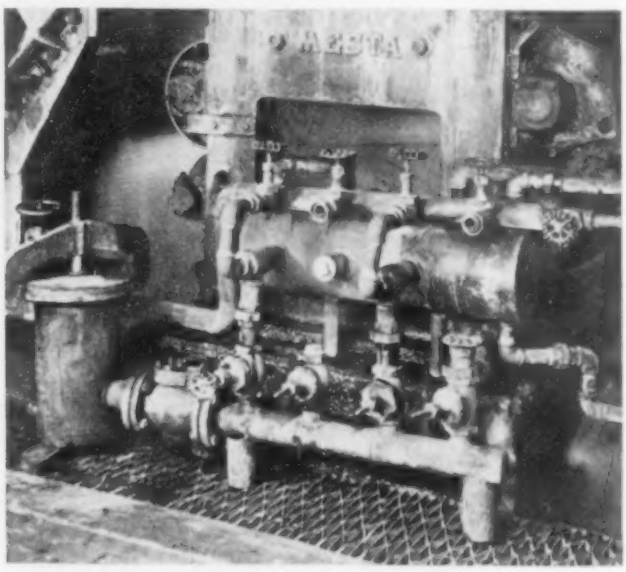


Fig. 8—Fabricated Hot Water Heater of Simple Design, for Heating Spray Water for Cleaning Alkaline Residue from Continuous Strip

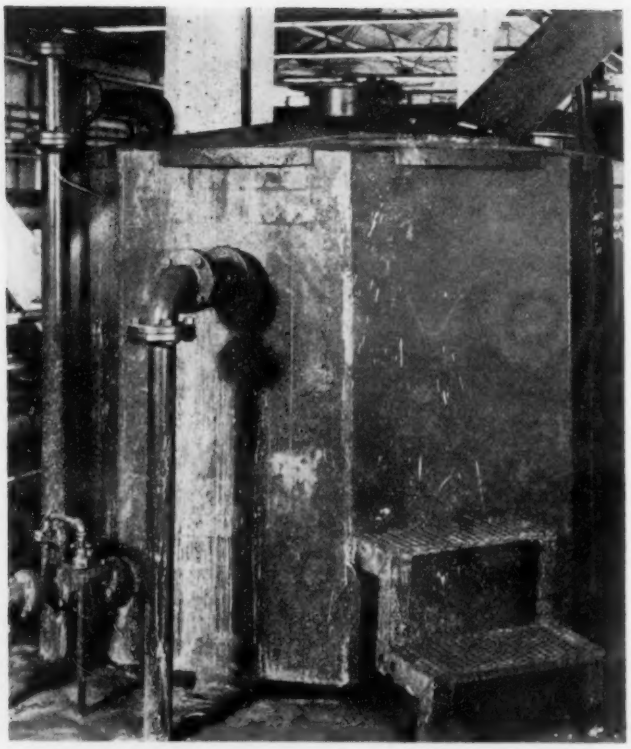


Fig. 9—These Bonderite Sludge Tanks Were Fabricated in Octagonal Shape When Bending Rolls Were Not Available

processed to eliminate foreign matter. Such reclamation pays big dividends to any large user of oil, and it was chiefly for this reason, together with the wartime scarcity of oil, that we decided to build the necessary apparatus for reclaiming oil as it became contaminated.

Since our regular supplier of mill equipment was unable to provide or build this equipment for us, due to lack of time, the maintenance department was asked to do it. The installation is fairly elaborate, but it was completed in three weeks by one welder and one helper, each of whom devoted about 80 hr. to the job during that time.

Figures 5 to 7 show various units of the installation.

Fig. 10—Details of Welded Reinforcement Are Shown on This Crane Hook, Made of Bent Bar Stock for a Gang Hook for Carrying Strip Coils

The oil-warming tank shown in Fig. 5 is made of $^1/_8$-in. plate, formed and welded with the electric arc. Steam pipes are coiled close to the shell on the inside, with welded fittings. This tank, about 3 ft. 7 in. in diameter holds 120 gal. of oil in the first stage of reclamation, in which heat is applied to emulsify and separate the water contamination in the oil. From here the oil flows by gravity to the centrifuge shown in Fig. 6, where the water content is removed centrifugally.

This centrifuge is mounted on a fabricated platform to raise it above a 75-gal. welded temporary storage reservoir which can be rolled in and out beneath the platform. Quarter-inch plate and angles were used in the construction of this platform, which is attractively and functionally designed. The oil is pumped from the temporary reservoir to a purifier where it passes through a fuller's earth treatment in a filter press, which eliminates any foreign solvents in the oil. This purifier was the only unit purchased from outside sources.

From the purifier the reclaimed oil is forced by compressed air to a sampling tank where samples are taken

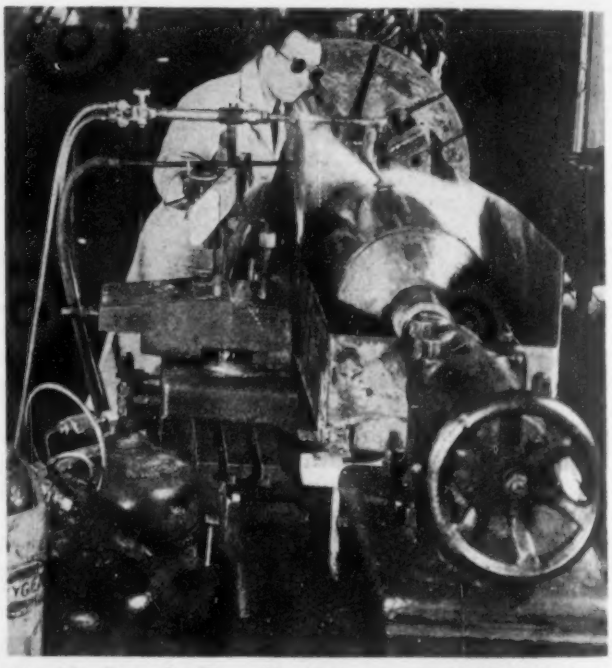


Fig. 11—Setup for Flame Hardening Tension Rolls Made from Discarded Work Rolls. Oxyacetylene Process Hardens the Surface to 95 Scleroscope. Considerable Savings Were Gained by This Reclamation Job

to determine whether further clarification may be needed. This fabricated tank is similar to the one shown in Fig. 5, but smaller. If the oil at this stage is considered acceptable it is pumped to one of the 600-gal. storage tanks shown in Fig. 7, or direct to a drum for immediate use. The storage tanks stand 10 ft. $3^1/_2$ in. high and are welded of $^1/_8$-in. plate and angle construction. Considerable piping and fittings also went into the installation, all of this auxiliary equipment being of welded construction.

## Minor Fabrications

Each of the preceding jobs was, in its way, fairly complex and called for considerable engineering as well as skill in construction. However, the bulk of the original fabrication work runs to simpler jobs. Typical of these is the hot water heater for a caustic tank, il-

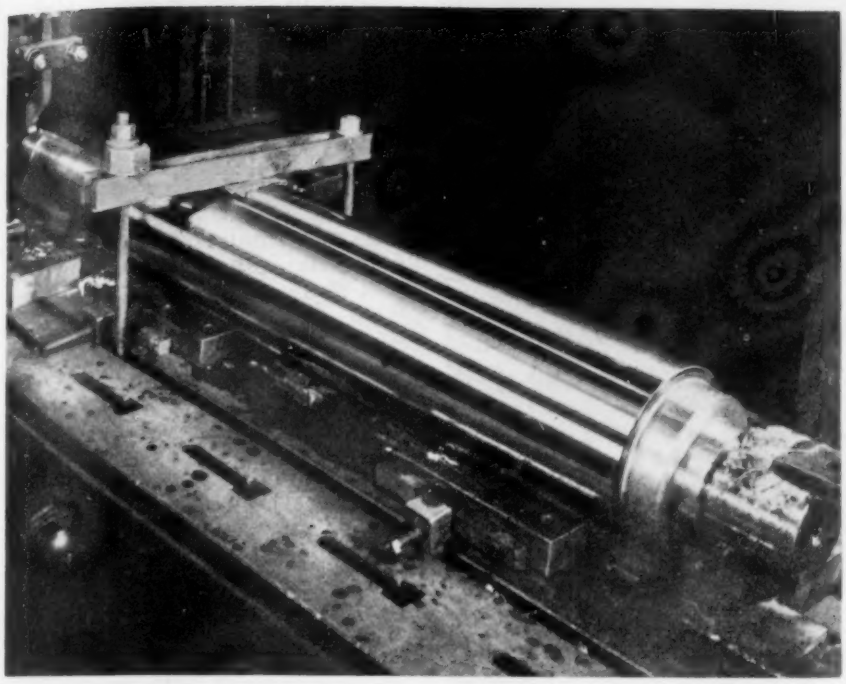


Fig. 12—This Pinch Roll Was Made of Three Forgings with Shrink Fits. The Roll Was Flame Hardened After Machining. Two Rolls Were Made at a Saving of $600

lustrated in Fig. 8. This unit consists simply of steam and water piping, with a hot water reservoir made of a length of 10-in. pipe, all operating on the steam injector principle. Water is heated almost instantly and sprayed over both surfaces of the moving strip as it comes out of an alkaline bath, washing and rinsing the strip and at the same time heating it sufficiently so that it dries by itself.

The row of bonderite sludge tanks shown in Fig. 9 offers another example of a comparatively simple fabrication. The shell of each tank is composed of four rectangular pieces of flame-cut plate, with a 135° bend across the middle, set up and welded together to form an octagonally shaped tank. This form was decided upon because bending rolls of the proper size to form a cylindrical shell were not available at the time these tanks were made. They illustrate once again the flexibility of the flame-cut and arc-welded method of fabrication in adapting the design to the facilities of production.

## Replacement Fabrication

The welded fabrication of replacement parts is usually a simple matter of cutting out sections of plate and joining them into an assembly which follows the general form and dimensions of the original part. The tendency in the past has been to be generous in providing an abundance of strength in the assumbly by using plate sections heavier than necessary. Lately, however, shortages of steel have dictated a more careful and conservative use of metal, without sacrificing necessary strength in the welded part. Particularly where a casting is to be replaced, lighter sections of rolled plate can generally be used than are found in the cast part.

An interesting small job of fabrication is the strip carrier hook shown in Fig. 10. This hook is one of three mounted on a gang carrier for moving coiled strip by crane. It is made of bar stock, heated and bent to correct shape, and then reinforced to prevent bending at the corners when under load. The three corners are stiffened by small flame-cut pieces welded to the outside of the bends as shown. The shank is trimmed with the torch, and a wide piece welded on to one side. This piece is then drilled for the supporting pin.

## Flame Hardening of Rolls

The procedure followed in the flame hardening of rolls is first to anneal the worn roll, followed by machining to reduce the diameter to tension roll size. It is then mounted on a slow-turning lathe, and the oxy-acetylene flame hardening apparatus is mounted on the lathe carriage, as shown in Fig. 11. A 4-in. multi-flame hardening tip is used to harden 11 successive bands around the roll face. Every precaution is taken to keep the roll cool during the flame-hardening operation, to avoid distortion and surface checks. The water-quenching jets in the torch tip are supplemented by an auxiliary quench, and in addition the roll is kept partly submerged in a water tank during hardening. If this care were not exercised, stresses might develop in the hardened surface, possibly resulting in cracks after the roll is placed in service.

The material is 0.85 carbon steel with a surface hardness after annealing of 30 scleroscope. Flame hardening raises this to 95, which is highly desirable since new rolls as received from outside sources varied in hardness between 70 and 90 scleroscope.

After experiencing this success in flame-hardening tension rolls we applied the process on two pinch rolls for a strip pickling unit. These rolls were made in our own shop, using separate forgings of 1045 steel for the roll proper and for the roll necks. To do this we bored both ends of the roll and machined the roll neck forgings 0.011 in. larger for a press fit into the roll. These shafts were then immersed in a bath of dry ice overnight to shrink them for pressing into the bored holes. Flame hardening of the roll face was done after completion of this operation without disturbing these shrink fits.

Twelve passes of the 4-in. flame-hardening tip covered the entire surface of each roll, completing the hardening operation in only $2^1/_2$ hr. per roll. The finished rolls,

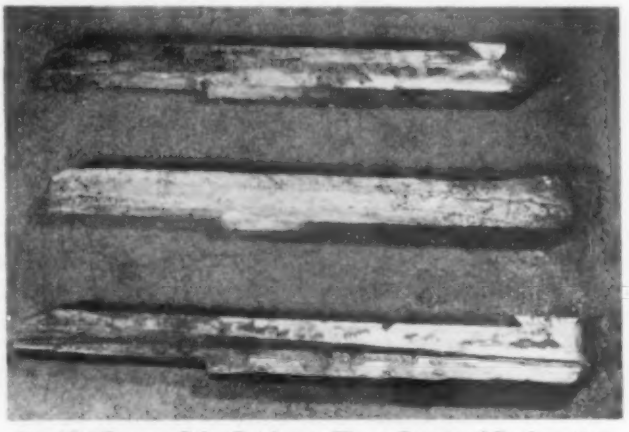


Fig. 13—Bronze Side Guides in Three Stages of Reclamation. At Bottom, Worn; Center, As-welded; Top, After Grinding. Guides Are 33 In. Long, $1^1/_8$ In. Thick

Fig. 14—Permanent Setup for Welding Worn Mill Guides. Both Sides of a Guide Are Repaired at One Time, Applying Phos-Copper with an Oxyacetylene Torch to Fill the Grooves Worn by the Strip

made at a saving of $600 for a set of two, have performed satisfactorily in service. Figure 12 shows one of the pinch rolls set up for a machining operation on a planer. We have found that the flame-hardening operation increases the service life of these rolls to about six months. After this period of service the roll usually shows sufficient wear to warrant grinding down to a new surface. Rehardening is not always necessary after such grinding, since the hardness penetration on the first application may be as much as $^3/_{16}$ to $^1/_4$ in., and if the grinding is done carefully so as not to draw the hardness, it should not be necessary to reharden until the roll has been ground several times. The same rolls are used repeatedly until successive grindings have worn them down to the minimum usable diameter.

## Reclaiming Worn Guides

One of the continuing reclamation operations is the building up of worn bronze side guides, used in both tandem and finish mill rolling to hold the strip in line as it runs to the tension reels. Some time ago we followed the practice of machining the grooved surfaces of the guides as they became worn. The depth of cut required to produce a smooth, flat surface was usually between $^1/_4$ and $^1/_2$ in., which meant that the guide could be planed and returned to service only three or four times before it was cut down too thin for use. Another disadvantage was that the

Fig. 15—Welded Bronze Guides Are Ground Flat on This Semiautomatic Grinding Jig. Sliding Work-bed and Spring-mounted Grinder Speed Up This Operation. Guides Are Reclaimed at 10% of New Cost

Fig. 16—Lead Burning Is a Regular Maintenance Operation. Here a Fabricated Steam Jet for Pickling Tank Is Being Assembled in the Shop

thin strip of guide which remained brought little return as scrap.

These bronze mill guides are now reclaimed repeatedly by welding. Figure 13 shows the usual condition of a guide as worn, and its appearance as welded and after grinding. Since this restoration work is a continuous job, with 25 or 30 guides being repaired each day, we have a permanent setup for heating, welding and grinding. The guides are first preheated in the oven furnace shown at the right in Fig. 14, and are then transferred to the welding bench. Preheat is maintained here by a natural gas burner beneath the workpiece. The filler metal used is Phos-Copper to provide an intermediate degree of hardness in the wearing surface.

As this is a comparatively simple operation we employ a cub welder on this work.

Grinding is done on the grinding jig illustrated in Fig. 15. In this simple setup the bronze guide is clamped on a sliding bed which the operator pushes back and forth beneath a pneumatic grinder. As shown in the photo the grinder is spring mounted, with a hand screw adjustment to govern pressure. With this device a flat finished surface is assured, and a high rate of production can be maintained.

A cost study made several years ago showed that the total cost of reclaiming a guide was $1.18, including materials and labor. As this is only about 10% of the cost of a new guide, the economy of repairing by welding instead of machining is obvious. The built-up guides give about four days' service, and with repeated welding and grinding they will last indefinitely. An incidental advantage of this method of reclamation is that small scraps of steel which sometimes embed themselves in the guide and score the moving strip may be easily removed during welding.

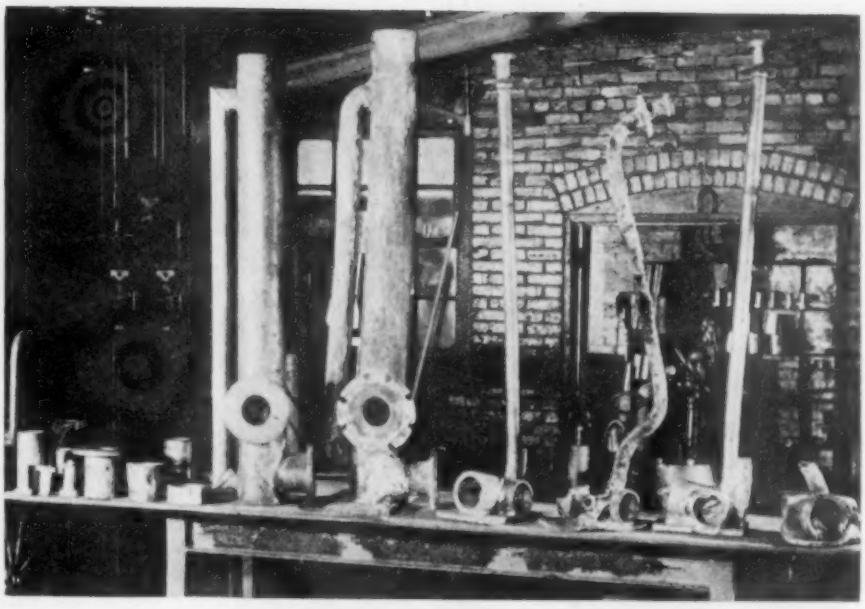


Fig. 17—Both Newly Fabricated and Used Steam Jets (Right) and Overflow Valves (Center) Are Shown Here. At Left Are Lead Castings Made in the Shop for These Assemblies

## Lead Burning

Maintenance of sulphuric acid pickling tanks and equipment involves an appreciable amount of lead burning to keep lead lining sheaths, piping, steam jets and other lead parts in good working order. In many respects the practice of lead burning is equivalent to steel welding and fabrication, but due to the ease of working with lead there is an even greater freedom in lead burning than in welding steel. This is particularly apparent in the ease of making lead castings and integrating them into a fabricated assembly by burning.

One of the parts which we fabricate in quantity is the steam jet shown in Fig. 16, used for heating the pickling solution. These jets corrode fairly rapidly in service, and while the remains of a corroded jet have some scrap value, the regular purchase of new jets would mount up to an appreciable item of cost. In our first effort to fabricate our own we saved 50% on cost, and now that we are building 10 to 12 jets per month the saving is even greater. The component parts of this assembly include a length of standard lead pipe and two tubes which we

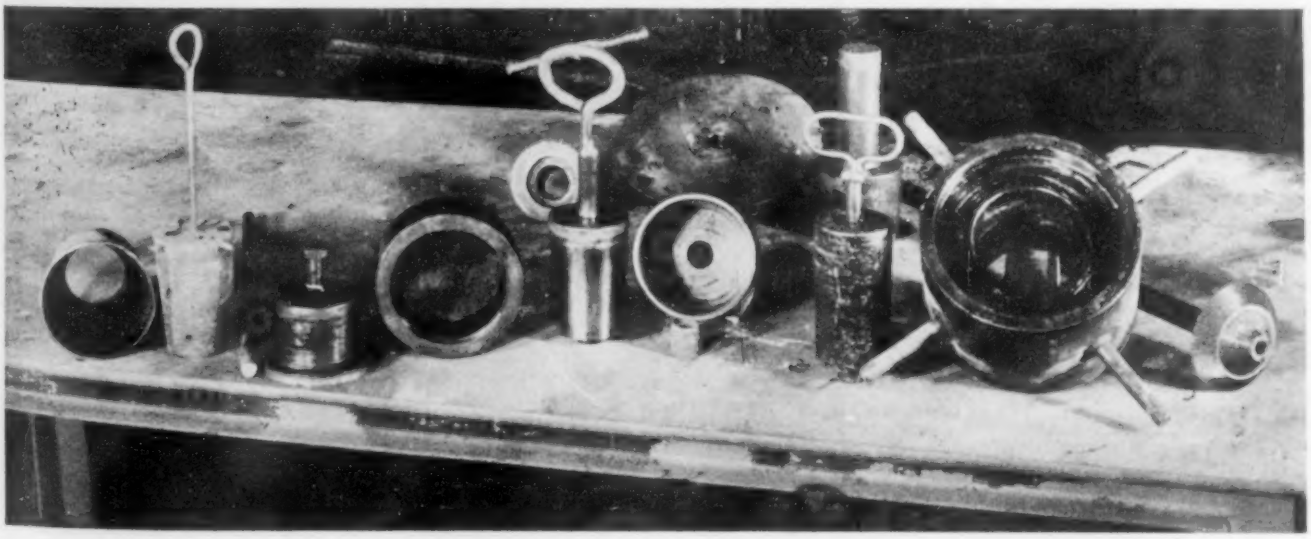


Fig. 18—Steel Molds Made in the Machine Shop for Casting Lead Parts for Fabrication Into Steam Jet and Overflow Valve Assemblies

Fig. 19—Worn Bearing Surfaces at Both Ends of This Roll Are Restored to Original Size by Depositing Steel Weld Metal and Then Machining

cast ourselves in steel molds made for the purpose. Several of the castings and molds used are illustrated in Figs. 17 and 18. A light oxyhydrogen torch is used both for burning and for "cutting" tube end profiles for joint making. Pure lead burning bar $^1/_4$ in. in diameter is used for the joints, but a small quantity of antimony is added to the molten lead for making castings, to give more hardness. The condition of these steam jets after being removed from service may be anywhere from fair to terrible, depending upon length of use, but it is a simple matter to repair those still serviceable and melt down the others for fabrication into new parts. Figure 17 shows both new and used jets, as well as several overflow and drain valves. The latter represent an even more interesting example of the practicality and economy of lead burning.

Before adopting fabricated lead overflow-drain valves, we had experimented with rubber-coated valves. These had proved unsatisfactory due to rubber breakage and disintegration under high temperatures. Further, the rubber coating was too easily cut. Corrosion-resistant castings were then tried, but these were both expensive and highly fragile. The extreme brittleness of the metal made it impossible to ream the seat for the drain control ball, and any other repairs were likewise impossible. The fabricated lead valve which was finally adopted has all the advantages of low cost, ease of reaming and making repairs, and comparative durability. It has been necessary to make very few of these so far, since occasional repairs keep used valves in service.

This valve is made chiefly of various lengths and diameters of lead tubing, cut to shape and joined with the oxyhydrogen torch. Flange rings and their adjoining short lengths of tubing are cast as units. The vital ball seating surface is reamed initially, and reseated as the need arises during service, by the reamer shown at the right in Fig. 18. The fabrication of this valve unit has resulted in a 25% saving in cost and has reduced maintenance problems immeasurably.

Lead burning not only enables any part to be built, repaired or salvaged, but also simplifies the task of installing and maintaining tank liner sheathing. Thin lead sheet is bolted to the inside of a fabricated steel pickling tank, with small patches of lead burned down over protruding bolt heads and washers. Large slabs $^1/_2$ to 1 in. thick for tank aprons and similar uses are made readily by pouring molten lead to the desired depth in a shallow steel mold. Such pieces can easily be bent and joined to others with the lead burning torch. Finally, any competent oxyacetylene welding operator can turn his hand to lead burning and, after a little practice, can perform whatever work may be needed in this field.

## Building Up Worn Steel Parts

The process of reclaiming worn steel parts by building up the worn surfaces with weld metal is so widely used that it scarcely needs mention, except to emphasize the importance of proper selection of weld metal. Before applying the overlay deposit it is essential to thoroughly study the conditions under which the worn part works. Important as this is, it is often overlooked, with the result that the reclamation job on the part itself or on other affected parts must be done more frequently than necessary.

The problem of selection of material in each case should be considered from two standpoints: first, the type of weld metal which will give the greatest wear resistance to the worn part itself, and second, the effect that this durable surface might have on any mating parts. The ideal material is the one which will require th least maintenance of the reclaimed part and mating parts in the long run. A good general rule to follow in selecting rod for general building-up purposes is to use a material whose analysis is similar to the base metal. Two typical steel mill maintenance operations of this nature are shown in Figs. 19 and 20 which il-

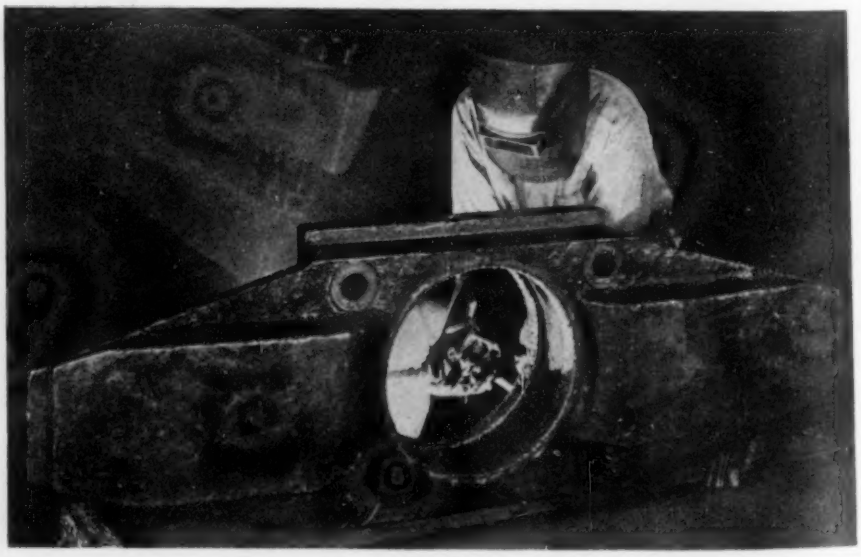


Fig. 20—A Loose Fit Between This Crosshead and Its Connecting Pin Is Being Corrected by Depositing a Layer of Weld Metal on Bearing Surfaces in the Opening

lustrate, respectively, the restoration of bearing surfaces on a mill roll and on a bearing housing. Unless the deposit is deliberately chosen to be of an appreciably different analysis than the base metal, it is usually not necessary to machine the surface prior to welding in order to insure a sufficient depth of overlay material after final machining.

Hard-facing materials should be used judiciously, remembering that if they are used on a sliding surface the wear may be transferred to another member which may be more difficult to repair. In this connection magnesium-bronze and lead-bronze welding alloys make excellent bearing deposits when it is desirable to confine the wear to the one member which can be most easily resurfaced.

## Welded Crane Rails

Our experience in welding crane runways by different methods has led to the development of our own technique for making welded joints between rail ends. Continuous welded rail is, of course, essential for modern roller-bearing mounted cranes, whose bearings would be jarred or damaged by uneven joints between rails.

On our first runway replacement job we employed Thermit welding, but discontinued this procedure because of the time and expense involved. In a succeeding job the method used was to vee the ball, web and flange of adjoining rail ends, and weld with the electric arc. While this method was cheaper and less cumbersome, it was unsatisfactory because the welds in the ball were softer than the base metal and tended to batter out under the action of the crane wheels, creating depressions in the running surface which jarred the crane and defeated the purpose of the welding.

As a result of this experience we devised the procedure used today, which is to vee only the web and flange of the rail, leaving the ball untouched, as illustrated in Fig. 21. The rail ends are then aligned and butted together, and weld metal is deposited over these welds, overlapping to a distance of 1 to $1^1/_2$ in. on both sides on web and flange, making a wide weld as shown in Fig. 22. The purpose of these heavy deposits is to utilize the contraction of the welds to draw the unwelded rail balls tightly together, creating a continuous surface for the crane wheels.

In addition to producing a highly satisfactory joint this method of welding is advantageous in that all work can be done directly on the runway, avoiding the need

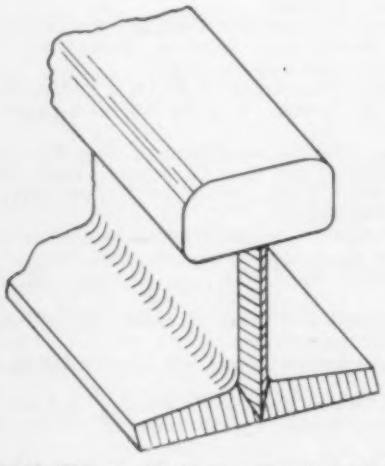


Fig. 21—Sketch Showing Method of Beveling Ends of Crane Runway Rails for Welding. Note That the Ball of the Rail Is Not Beveled

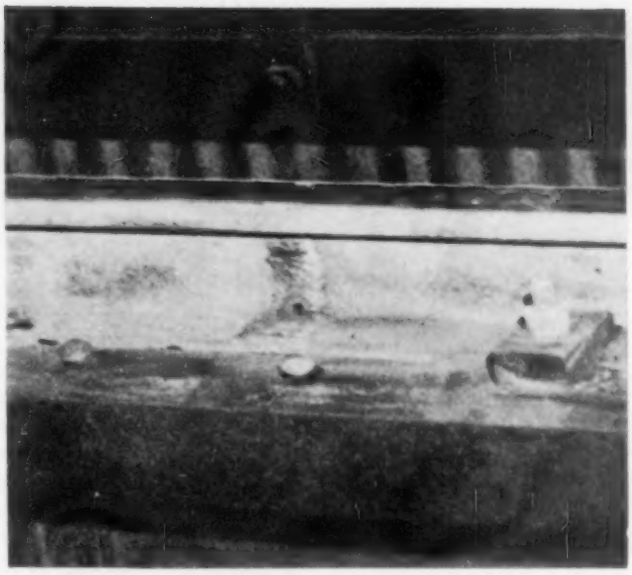


Fig. 22—Rail-End Joint on Crane Runway Is Welded on Web and Flange Only, with Heavy Reinforcement

to hoist long sections of partially welded rail from the floor to the runway. Moreover it is fast. In one instance the maintenance department welded and laid 1025 ft. of crane runway in less than four days. At present all runways in every part of the plant except for two buildings with short runways are welded.

An unusually interesting problem in runway maintenance has recently arisen in one of our shops. Over a period of years, a number of the main building columns in this shop have settled, causing the crane runways supported by these columns to be considerably out of level.

To correct this condition as it affects the runways we have decided to simply cut the runway loose from the

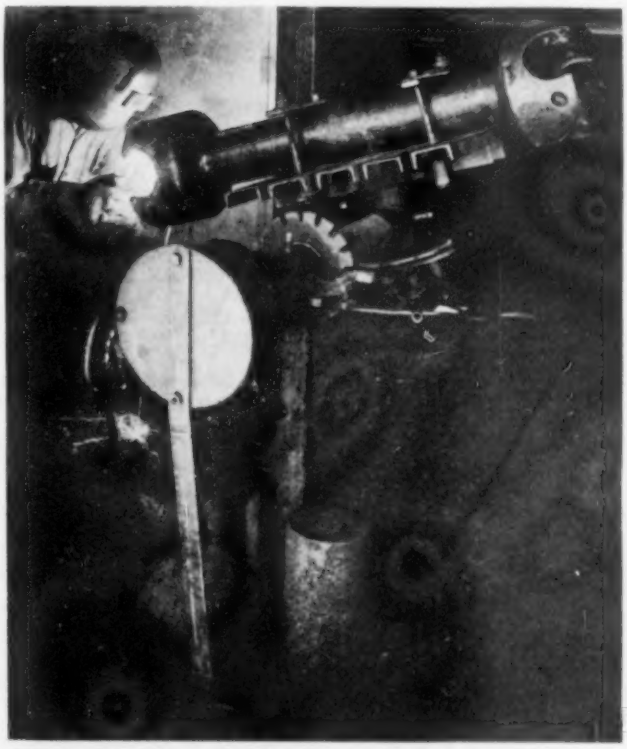


Fig. 23—This Versatile, All-position Welding Positioner Was Designed and Fabricated by the Mill Maintenance Department to Serve Their Own Needs

settled columns with a hand torch, jack it up to level height, and weld it back into place. To do this, eight rivets will be washed out and three neat cuts made in knee braces and diaphragm plate, then a splice plate will be fitted over each cut. After jacking, the cut edges will be welded together and the splice plates welded over these joints for reinforcement.

### Miscellaneous Maintenance

The number and variety of unclassifiable maintenance jobs in a steel mill is limitless, and here I will not attempt to do more than to suggest what can be done by a versatile, well-organized department. Work formerly done by riveting, such as making repairs or extensive alterations to roof trusses, can be conveniently done by welding.

The shop-built welding positioner shown in Fig. 23, providing for 360° rotation in all three planes, is illustrative of the ingenuity displayed by the maintenance personnel in caring for the needs of the plant. As stated previously, the volume of such extra work which can be handled by the department in addition to essential maintenance jobs is not seriously limited by the size of the department, but depends upon the prompt utilization of idle time. When the amount of regular work to be done is not great, each job somehow takes longer. But when the department is seemingly overloaded with work, somehow everything gets done without working overtime. With a comparatively small stock of materials including plates structural shapes and pipe, the mill maintenance department is prepared to cope with almost any problem. It becomes habitual, whenever a new problem arises, to think immediately in terms of the welding processes, which are so handy in mill work that other methods are seldom even considered.

---

## Current Welding Literature

(*Continued from page 1019*)

Gun Carriages. Welding of "Long Tom," E. S. Lee. Industry & Welding, vol. 17, no. 6 (June 1944), pp. 28–30, 86, 88, 90–91.

Gun Mounts. Tanks for Big Navy Guns, T. B. Jefferson. Welding Engr., vol. 29, no. 5 (May 1944), pp. 39–41.

Heat Treatment. High-Frequency Induction, H. B. Osborn, Jr. Western Machy. & Steel World, vol. 35, no. 5 (May 1944), pp. 198–199.

Internal Combustion Engines. Repairing Cracked Cylinder Blocks by Electric Bonding, L. E. Kunkler. Steel, vol. 115, no. 3 (July 17, 1944), pp. 125, 182, 184.

Internal Combustion Engines. Power Unit Life Extended by Reconditioning Valves, E. Sterrett. Oil Weekly, vol. 114, no. 13 (Aug. 28, 1944), pp. 17–18, 20.

Iron and Steel, Stress Relief. Experiments in Stress-Relieving Castings and Welded Structures by Vibration, R. T. McGoldrick and H. E. Saunders. Metallurgia, vol. 30, no. 176 (June 1944), p. 118.

Jigs and Fixtures. Precambering Technique in Welding-Fabrication of Hatch Covers, G. E. Stedman. Steel Processing, vol. 30, no. 7 (July 1944), pp. 421–424.

Jigs and Fixtures. Tooling for Magnesium Welding, K. L. Kime. Iron Age, vol. 154, no. 9 (Aug. 31, 1944), pp. 33–40.

Life Rafts. Lives Depend Upon Welding. Industry & Welding, vol. 17, no. 6 (June 1944), pp. 53, 55–57.

Machinery Manufacture. Design of Fabricated Machines, F. Koenigsberg. Iron & Coal Trades Rev., vol. 148, no. 3982 (June 23, 1944), pp. 962–963.

Machinery Manufacture. Intricate Machine Parts, A. E. Bedell and T. G. Morrison. Steel, vol. 114, no. 26 (June 26, 1944), pp. 90–92, 94, 139.

Machine Shop Practice. Engineering Production Annual 1944, editor, H. H. Jackson. Paul Elek (Publishers), London, W. C. 2. 102, pp., 8*s*. 6*d*.

Materials Handling, Airplane Plants. Saving Wasted Manpower by Improved Handling, E. J. Strickland. Factory Mgmt. & Maintenance, vol. 102, no. 7 (July 1944), pp. 89–91.

Metals Analysis, X-Ray. General Discussion on Radiological Testing. North East Coast Instn. Engrs. & Shipbldrs.—Trans., vol. 60, pt. 8 (July 1944), pp. 299–322, (discussion), D169–186; see also extracts in Elec. Rev., vol. 134, no. 3467 (May 5, 1944), pp. 627–628.

Metals Analysis, X-Ray. Radiology in Engineering, S. F. Dorey. Iron & Coal Trades Rev., vol. 148, no. 3975 (May 5, 1944), pp. 675–676.

Metals, Hard Facing. Deposition of Hard-Facing Alloys by Welding, P. L. Pocock. Metallurgia, vol. 29, no. 174 (Apr. 1944), pp. 289–292.

Metals, Surface Capillarity. Capillarity of Metallic Surfaces, E. R. Parker and R. Smoluchowski. Am. Soc. Metals—Preprint, no. 13, for meeting (Oct. 16–20, 1944), 10 pp.

Milling Cutters, Manufacture. Modern Milling-Cutter Production, F. Mueller. Engrs.' Digest (American Edition), vol. 1, no. 9 (Aug. 1944), pp. 514–515.

Oil Tanks, Salvaging. Erecting 27 Tanks from Salvaged Plates Saved Day for Sour Crude Pipeline, E. P. Shelton. Nat. Petroleum News, vol. 36, no. 36 (Sept. 6, 1944) (Sec. 2), pp. R608–609.

Pickling Plants, Equipment. Light Weight-Long Life Pickling Equipment from Welded Wrought Materials, H. R. Strohecker. Steel Processing, vol. 30, no. 6 (June 1944), pp. 358–360.

Pipe, Concrete, Reinforcement. Winding and Welding Steel Cages for Reinforcement of Concrete Pipe, W. A. Shelton. Civ. Eng. (N. Y.), vol. 14, no. 7 (July 1944), p. 301.

Plates, Stresses. Strengthening of Circular Holes in Plates Under Edge Loads, L. Beskin. Am. Soc. Mech. Engrs.—Trans. (J. Applied Mechanics), vol. 11, no. 3 (Sept. 1944), pp. A-140–A-148.

Pulleys, Manufacture. Automatic Roll Forming, G. W. Birdsall. Steel, vol. 115, no. 6 (Aug. 7, 1944), pp. 86–90, 150, 152, 154.

Railroad Maintenance of Way. Welding in Modern Permanent Way Practice, P. Croom-Johnson. Ry. Gaz., vol. 81, no. 8 (Aug. 17, 1944), pp. 160–164.

Road Machinery, Scrapers. New Scraper Blades from Old by Welding, G. Hall. Pub. Works, vol. 75, no. 6 (June 1944), pp. 23, 73.

Roads and Streets, Portable. Fabricating Steel Invasion Mats. Steel Processing, vol. 30, no. 6 (June 1944), pp. 349–352.

Shipbuilding. Automatic Welding for "Victory" Ships, M. H. MacKusick. Western Metals, vol. 2, no. 7 (July 1944), pp. 24–25.

Shipbuilding. Design of Welded Ships, A. G. Hadjispyrou. Instn. Engrs. & Shipbldrs. in Scotland—Trans., vol. 87, pt. 7 (June 1944), pp. 212–237.

Shipbuilding, Oxyacetylene Cutting. Flame-Cutting in Shipyard, G. M. Boyd. Inst. Welding—Trans., vol. 7, no. 2 (July 1944), pp. 79–94, (discussion), 94–98.

Shipbuilding. Time Studies of Welding Arc Increase Production Efficiency, R. R. Dysart. Log, vol. 39, no. 4 (Apr. 1944), pp. 77, 94.

Shipbuilding, Welding vs. Riveting. Ship Structural Members—II, C. S. Lillicrap and C. J. G. Jensen. Instn. Engrs. & Shipbldrs. in Scotland—Trans., vol. 87, pt. 7 (June 1944), pp. 151–160, (discussion), 160–182.

Steel, Weldability. Recent Progress in Application of Welding to Steel, W. F. Hess. Steel Processing, vol. 30, no. 6 (June 1944), pp. 370–371, 392; No. 7 (July), pp. 430–431, 435; No. 8 (Aug.), pp. 501–503.

Steel. Weldability of Steel, M. Seyt. Metal Progress, vol. 46, no. 1 (July 1944), pp. 67–73.

Tube Mills for Russia. Steel, vol. 115, no. 7 (Aug. 14, 1944), pp. 104, 160.

Tubes. Distortion Control in Welding Tubular Assemblies—III, E. Christie. Industry & Welding, vol. 17, no. 4 (Apr. 1944), pp. 25–26, 96.

Ventilation for Welding Booths, M. E. Ringquist. Heating & Vent., vol. 41, no. 6 (June 1944), pp. 62–64.

(*Continued on page 1047*)

# The Welding and Heat Treating of Couplers and Other Car Parts*

By John McMullen†

THE long-standing tradition of taking every precaution in the interests of safety, which has been a hallmark of railroad maintenance for decades, has retarded acceptance by the railroads of certain applications of welding, while encouraging it in other applications. Prior to the war when replacement parts were readily available, most roads did not seriously question the AAR rules and restrictions regarding welding on certain parts and areas of parts which are subject to high stress concentrations. The attitude has always been that new developments and applications of welding would be reviewed for possible acceptance only after exhaustive tests had been made; and in the normal scheme of things, there was little motive for making such tests.

One of the principal effects of the war as it affected the railroads has been that because of the shortage of replacement parts, numerous parts which would formerly have been scrapped and replaced are now being repaired by welding, and that these reclaimed parts have proved entirely safe and satisfactory in service. In the case of car couplers, whose reclamation will be described in detail in this paper, the repaired couplers are at least as good, on the average, as new couplers because of the heat treatment which follows welding. This includes those couplers which are now being welded in areas where, under former AAR interchange rules, welding was strictly prohibited. These rules were recently relaxed as a wartime expedient to reduce the number of new couplers needed. Since couplers are subjected to heavier punishment than any other part, and since our success in welding couplers and related parts has led to the relaxing or abolition of restrictions on welding other parts, a brief account of the history of this change in AAR regulations is in order, before giving a description of the methods used at Erie in reclaiming cracked couplers on a production basis.

## Tests Authorized

During the wartime year of 1941 the Erie Railroad alone purchased 5400 new couplers, while damaged couplers were being returned by the hundreds and thrown into scrap. We made an inspection of approximately 500 of these couplers and found that about 77% of those normally scrapped could be reclaimed if such repairs would be authorized.

Three months after Pearl Harbor, in February of 1942, I offered the suggestion to V. R. Hawthorne, Executive Vice-Chairman of the Mechanical Section of the AAR, that in order to conserve steel and to relieve the increasing burden upon steel foundry facilities and man power, the railroads ought to salvage every damaged coupler that was not totally beyond reclamation. Mr. Hawthorne immediately asked the Coupler and Draft Gear Committee to call an early meeting to consider ways of determining whether unrestricted welding could be permitted, and the regulations changed accordingly, without jeopardizing the safety of railroad operation. At this meeting, which was held in March 1942, it was decided to order tests made on welded couplers, following the same procedure that had been adopted previously by the Car Construction Subcommittee on Welding, for the testing of truck side frames. Selected specimens would be welded through 40, 60–75 and 100% of section, normalized, and then subjected to the standard tests required of new cast parts.

## Results of Tests

The regulations previously in force prohibited welding on couplers except for minor cracks and for building-up worn areas, but only at points where stress concentrations were lowest. On yokes, limited welding was permitted in the front end, but not at the rear, on the straps, nor at the front of keyway. Specimens prepared for testing had cracks in one or more of the forbidden areas, to be subjected to impact, tension or a combination of both stresses. Figures 1 and 2 show typical results on these tests. The Type D couplers in Fig. 1 have survived the dynamic guard arm test, in which a 1640-lb. tup was dropped repeatedly on the nose of the guard arm of couplers having welded front face cracks, with the shank supported in a vertical position. This test was continued in each case until the guard arm and shank had bent so much that the follow-tup missed the guard arm, and there was no point in carrying the test further. Not one of the cracked and welded couplers failed on this test. These results indicated that it is perfectly safe to make front face welds on cracked couplers. On the other hand, undam-

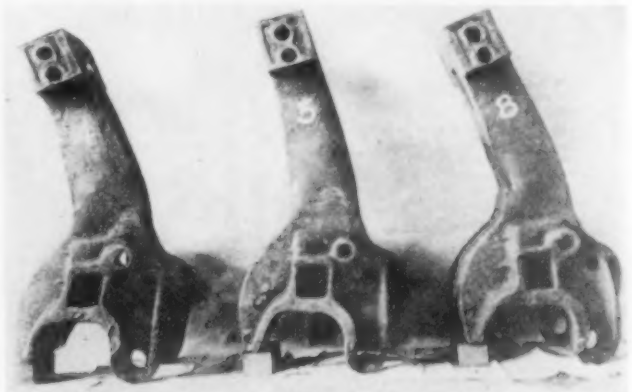


Fig. 1—Test Specimen Couplers After Dynamic Guard Arm Test. These Three Couplers Had Front Face Welds, None of Which Failed in the Test. Impact Blows Were Discontinued After Shanks Had Bent Far Out of Line

* Presented at the Twenty-Fifth Annual Meeting, A.W.S., Cleveland, Ohio, Oct. 16 to 19, 1944.

† Consulting Engineer, Erie Railroad Co.

Fig. 2—Yoke Test Specimen at Left Had a Welded Crack in the Strap, But Resisted 50 Heavy Blows and Showed a Tensile Strength of 401,000 Lb. on Destruction Test. Specimen at Right Had Welded Cracks in Strap and Front End, Failed at 532,000 Lb. No Welds Failed in Either Yoke

aged second-hand couplers that were neither welded nor heat treated, all failed in a few drops of the tup, indicating that couplers which have been in service for any length of time should be normalized to enable them to withstand the impact blows received in service.

Couplers with welded cracks in the shank were tested to destruction in the static tensile test, with some of this type of repaired coupler being first subjected to an impact test under a 9000-lb. tup. Among the latter was a coupler welded 100% across the shank, made up of the front end of one coupler and the rear end of another,

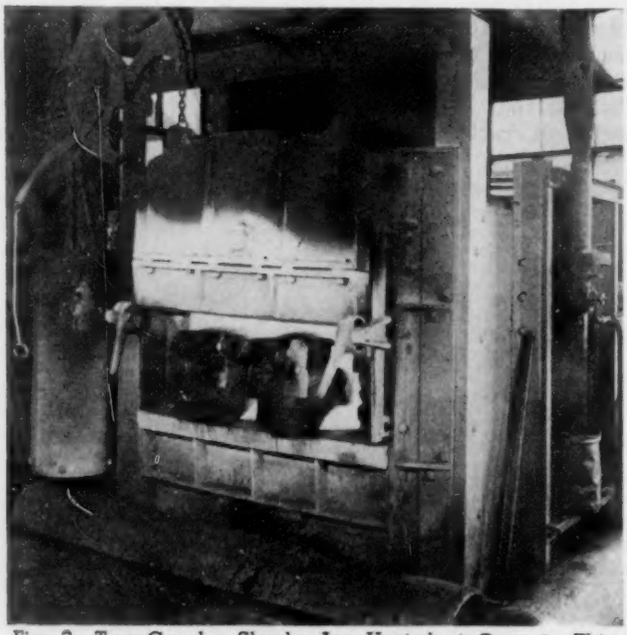


Fig. 3—Two Coupler Shanks Are Heated at Once in This Small Furnace Preparatory to Straightening

welded together. Tensile test failures on these specimens occurred about 10 in. away from the weld, indicating that the weld holds up better than the parent metal, and that therefore there is no reason why welding cannot be safely done on the shanks.

The welded yokes were given both impact and tensile test, receiving 50 blows of the 9000-lb. tup before being pulled to destruction. In these tests nothing occurred to indicate that it is unsafe to weld either the straps, the pulling lugs or cracks in front of the key slot.

In every case the couplers, yokes and side frames were put through the same tests required of new parts, under the supervision of AAR representatives, and all test requirements were met. On the destruction tests, when failure occurred it was always outside of the weld and the weld area, never near the weld. This proved that in a welded and heat-treated part the weld metal holds up better than the parent metal.

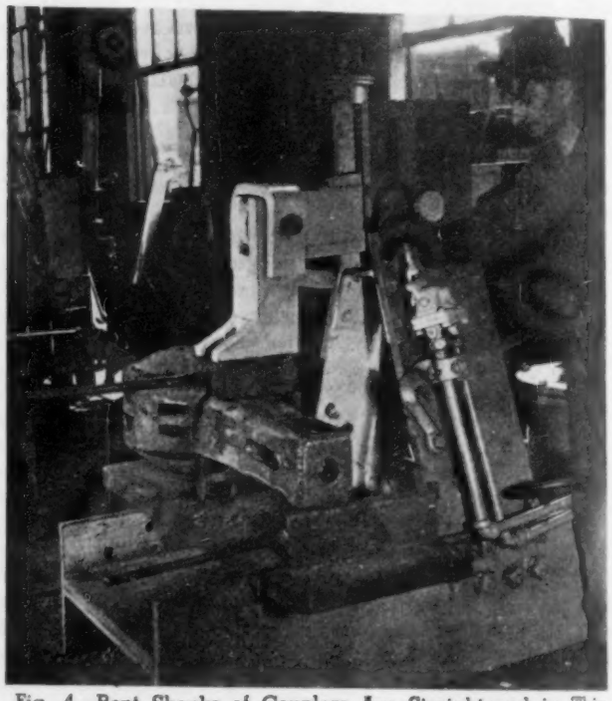


Fig. 4—Bent Shanks of Couplers Are Straightened in This Pneumatic Press Before Any Welding Is Done

With this body of evidence to prove that the then existing interchange rules governing welding were unnecessarily restrictive, the general committee of the mechanical division of the Association of American Railroads later authorized unlimited welding on couplers.

## Important to Normalize

One significant factor brought out by these tests is that proper heat treatment after welding adds greatly to the physical properties of the part, and is in fact an essential part of the repair work. The tests showed further that this heat treatment should be a normalizing process, and not an annealing process. Normalizing consists of gradually heating the part to just within the critical temperature range and maintaining this heat only long enough to secure full penetration, usually one hour per inch of thickness of the part, then cooling in still air. This procedure eliminates all internal stresses and also refines the grain structure at the weld, without causing grain growth and softening.

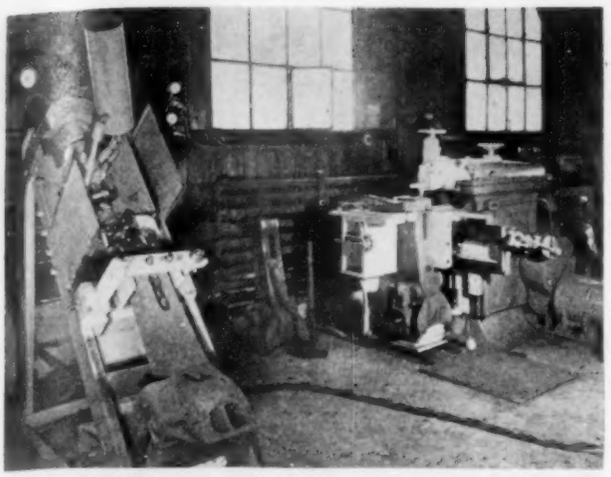


Fig. 5—Butt Faces Are Squared on Either of These Two Machines, Before or After Welding as Required. Note Special Holding Fixtures for the Couplers

Annealing consists of either heating to a higher temperature than normalizing, or holding the part in the furnace longer, and in some cases, allowing to cool in the furnace. While this process eliminates stresses, the prolonged heating at a point above the critical temperature has the undesirable effect of causing a coarse granular structure which weakens the steel. An annealed coupler or yoke will stretch beyond the permissible limits. It follows from this that the heat treatment of welded couplers and other parts should not be done haphazardly as it is in some shops, but should be entrusted to an operator trained in heat treatment, and that a sealed furnace governed by pyrometric heat control should be used. Regardless of how good a weld may be, unless the part is carefully heat treated in accordance with the prescribed rules, it is likely to fail, and welding will be blamed for the failure.

Fig. 6—Under New Emergency AAR Rulings It Is Now Permissible to Weld Head Cracks Such as This on Freight Car Couplers

## Reclamation Procedure

Shortly after the official adoption of the new rulings, the Erie Railroad set up a new reclamation plant to handle the influx of cast steel parts to be welded. This shop has been in operation since March 1943, reclaiming

Fig. 7—Cracks Are Veed Out with a Cutting Torch and No. 2 Tip in Preparation for Welding

couplers at an average rate of 371 per month. Under former regulations almost all of these would have been scrapped. In addition the plant handles welded repairs on 1500 knuckles per month, 3000 lock lifters, 1500 knuckle throwers, 500 coupler lock blocks, 8 or 10 bolsters and about 50 truck side frames per month.

The procedure followed in repairing cracked steel castings of any kind is as follows:

1. Cracks and porous sections are cut out with an oxyacetylene torch, veeing the cracks for welding.
2. Slag and scale are cleaned out.
3. Welds are deposited.
4. Welded areas are cleared of slag and ground reasonably smooth.
5. The entire part is carefully inspected under good lighting.
6. The part is placed in a heat-treating furnace equipped with automatic controls and temperature recording devices, and heat is applied in accordance with prescribed rules based on metallurgical research and experience.
7. The heat-treated part is again inspected to discover any additional cracks that may have shown up as a result of the heat treatment.

The first operation in reclaiming couplers sent to the

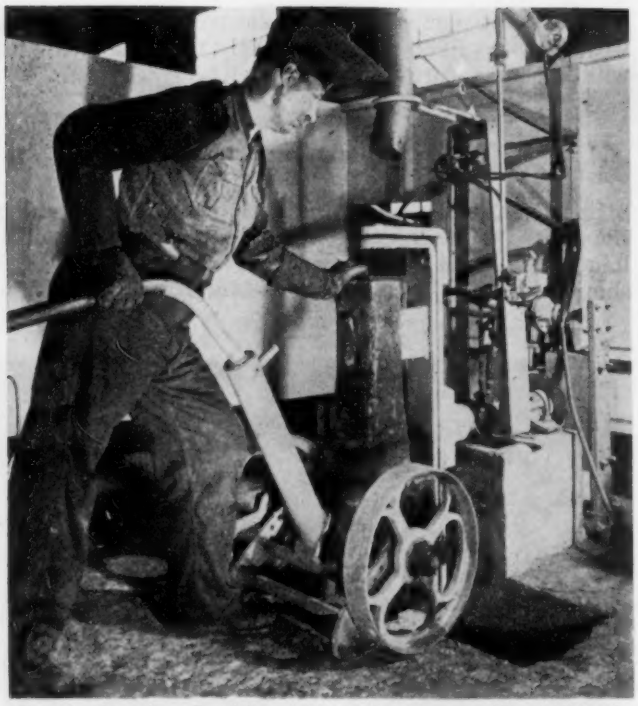


Fig. 8—Couplers Are Moved About the Shop on Special Hand Trucks Which Eliminate Hand Lifting Entirely. Here a Coupler Is Slipped Onto One of the Welding Positioners

Fig. 10—Dressing a Finished Weld in Coupler Face, Using a Pneumatic Hand Grinder. A Simple Rotating Positioner Is Now Used in Grinding

Meadville plant for repair is to straighten the shanks and guard arms if necessary. For this operation the parts are heated in the small furnace shown in Fig. 3, then transferred to the pneumatic straightening press shown in Fig. 4, where the bent shanks are brought back into alignment. Next, the butt end is examined to determine the best method of restoring it to its original dimensions. Several alternate methods are used, depending upon the condition of the butt. The preferred method is to build up with weld metal on the end, or in the keyway if space permits, or on both areas. The maximum amount of building-up with weld metal on any butt end is $^5/_{16}$ in.; if greater height is required, a steel plate is welded onto the end. However, the welding of a plate is avoided whenever possible because the plate

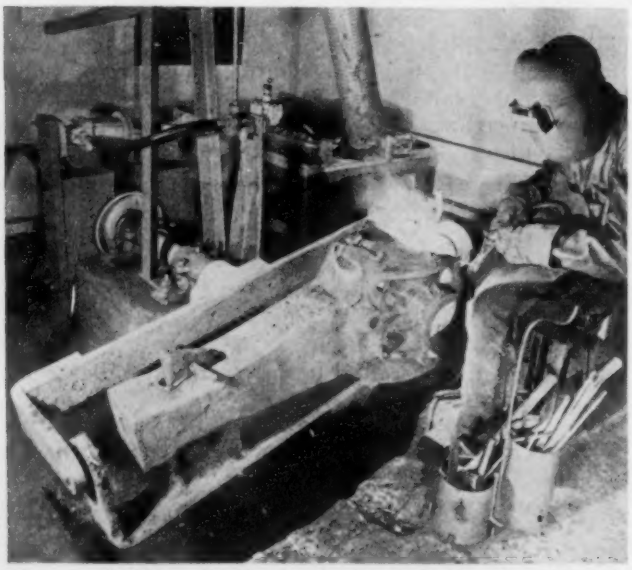


Fig. 9—Welding Cracks Inside Head of Coupler. Partial Welds in Knuckle Back Wall Are Already Deposited. Note Construction of Shop-Built Positioner. Small Air Cylinder at Rear Brakes the Positioner at Any Point of Rotation

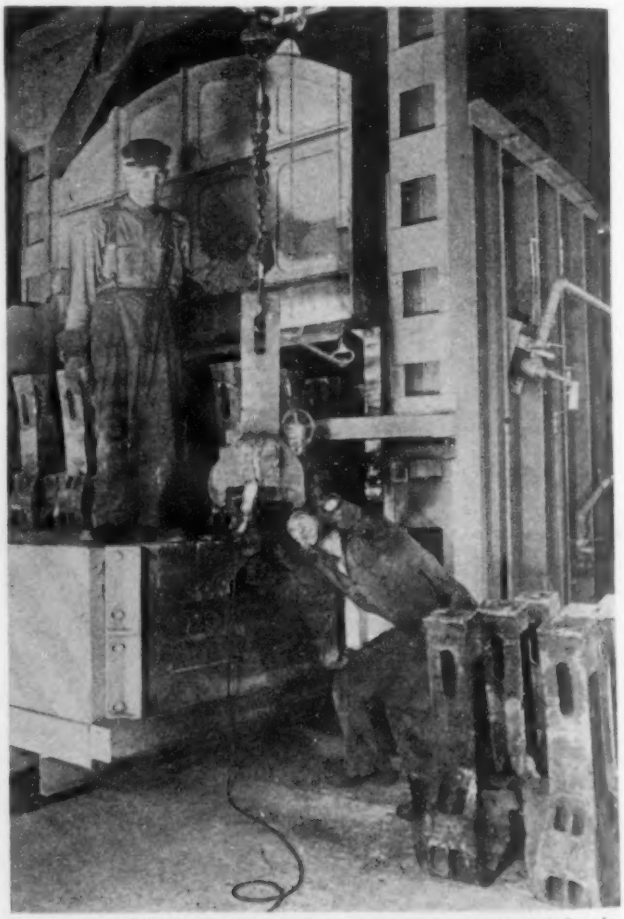


Fig. 11—Welded Couplers Are Thoroughly Inspected Inside and Out Before Going Into the Furnace for Heat Treatment. Inspector Uses a Portable Tubular Light to View the Interior. Air Hoist Speeds Up the Loading Process

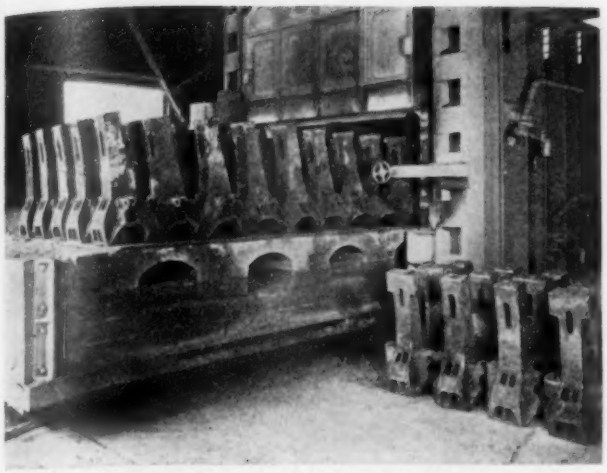


Fig. 12—Here a Full Charge of 45 Welded and Normalized Couplers Is Ready to Be Unloaded After Slow Cooling Overnight. The Furnace Has Automatic Controls and Temperature Recorder to Insure Proper Normalizing

tends to blister up under battering in service, whereas an over-all weld deposit cannot do so as there is no air space to promote blister formation. Moreover, experience has shown that plates $^{5}/_{16}$ in. or less in thickness may also break in service. Heavier plates of the proper composition prove satisfactory. Plates of different thickness are also welded around the follower block pinhole and the outer edge, with the ends finally trimmed by grinding.

All butt ends are faced by machining, either after the welding operation in the case of built-up ends, or before welding if a plate is to be welded on. Two machines, shown in Fig. 5, are employed for facing the butts square. Both were specially constructed in the shop for this purpose, and are equipped with special jigs for holding the couplers. The rotary facing machine at the left in Fig. 5 is powered by a compressed air motor, and has a rotating, self-feeding head. The second machine is a standard electric shaper, fitted with a holding device for the workpiece. Butts are machined square to within $4^{3}/_{32}$ in. but not less than 4 in. from the end of the key slot.

The couplers are then inspected for cracks. These are found to occur most frequently in the back wall and the guard arm, and in the face where it joins the guard arm, with some cracks occurring in the keyway. Figure

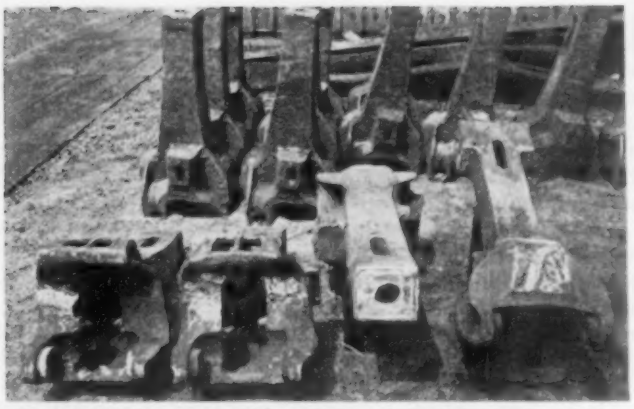


Fig. 14—Various Welded Couplers with Welds in Head, Face, Guard Arm, Back of Head, Around Knuckle Pinhole, etc.

6 shows a crack in the coupler face which is permissible to weld under the new rulings. Such cracks are veed out with a cutting torch as illustrated in Fig. 7, using a simple holding fixture which permits easy rotation of the coupler to bring the affected areas into convenient working position.

After cleaning to remove slag, the prepared coupler is moved on a special hand truck to one of the welding booths. These hand trucks, shown in Fig. 8, aid considerably in simplifying an otherwise cumbersome job. No manual lifting is necessary either to pick the coupler off the floor, or to transfer it from the truck to the welding positioner. The positioner itself, shown in Figs. 8 and 9, is shop-made and provides for 360° rotation in two directions so that all welding may be done in the fast down-hand position. The vee grooves are filled with weld metal, using $^{3}/_{16}$-in. electrodes conforming to A.W.S. classification E 6010. The welds are then lightly ground, using a rotating fixture similar to that employed in veeing the cracks. A small unwelded area is also smoothed by grinding to receive the die-stamped indications of date of welding, name of railroad, shop designation and the welder's number, to comply with AAR specifications. It is important that these markings be legible to insure positive identification of the railroad performing the work. The coupler is then inspected preparatory to heat treatment.

The word "inspection" means more than a cursory glance. One of the observations made in the aforementioned tests was that minor, concealed cracks left unwelded might easily cause failure of a coupler which

Fig. 13—Typical Welds Made on Freight Car Couplers. Crack on Coupler at Left Extended Along Knuckle Back Wall Into Shank. Butt End at Right Was Built Up by Welding, Then Machined

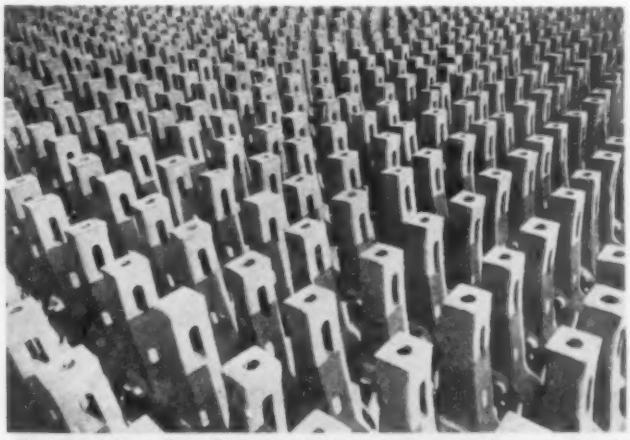


Fig. 15—The Erie Railroad Began Accumulating Damaged Couplers in Anticipation of AAR Approval of Welding. Almost All of These Couplers Would Formerly Have Been Scrapped Due to Cracks in Shanks or Heads

had been carefully welded in other respects. Figure 11 shows how the interior of a welded coupler is inspected with the aid of a tubular light while suspended by an air hoist preparatory to being loaded on the furnace car floor. Such inspections are carried out at least four times during the progress of coupler reclamation, to discover hidden cracks which may be brought out by processing along the route.

Welded couplers are loaded on a car-floor type heat-treating furnace for normalizing. Forty-five couplers make up a full charge, appearing as in Fig. 12. Loading is done with a compressed air hoist on a short monorail, which speeds up this operation considerably. The furnace itself is oil fired, with micromax heat control, and has sand seals around the car floor to stop leakage and drafts. Accurate heat control, which is so essential in proper normalizing, is therefore assured. The couplers are heated slowly from room temperature to 1525° F. in 2 hr., and are then maintained at that temperature for 1 hr. and 45 min. The car floor is then withdrawn into the still air of the shop building and allowed to cool gradually to complete the normalizing treatment. The heating cycle, incidentally, is arranged so that the car floor is not bought out until quitting time for the shop men, to avoid their having to work adjacent to the hot mass of the furnace charge in the shop. The cooled couplers are reinspected the following day to determine whether new cracks might have appeared after the heat treatment had burned off old scale and rust. Cracks have seldom been found at this time, the total over a period of more than a year being only fourteen.

Figures 13 and 14 show typical welded repairs made on couplers. In addition to the types of repairs illustrated here, one other is worthy of mention. This is the making of a sound coupler from the salvageable portion of two badly damaged couplers, one having a good front end and the other a good rear end. These are cut squarely across at the shank, the good parts lined up in position and welded in the vee grooves all around the shank. As mentioned previously in the paragraphs on tests, a coupler repaired in this way proved entirely satisfactory on test, and those which have been reclaimed in this manner and installed in service have operated successfully.

## General Observations

Railroad men concerned with welded reclamation of cast steel parts cannot lay too much stress on the importance of normalizing, for several reasons. In addition to the fact that stresses are introduced into the casting by the heat of welding, consideration must be given to the fatigue and crystallization set up in service by the severe batter and abuse which couplers normally receive. The normalizing heat treatment applied at the time of making welded repairs corrects all these conditions and starts the coupler out with a new life. If normalizing is not done, or is done improperly, failure is likely to occur later, and though this failure might in some cases be due to fatigue, it is more than likely that it would be attributed to the welding.

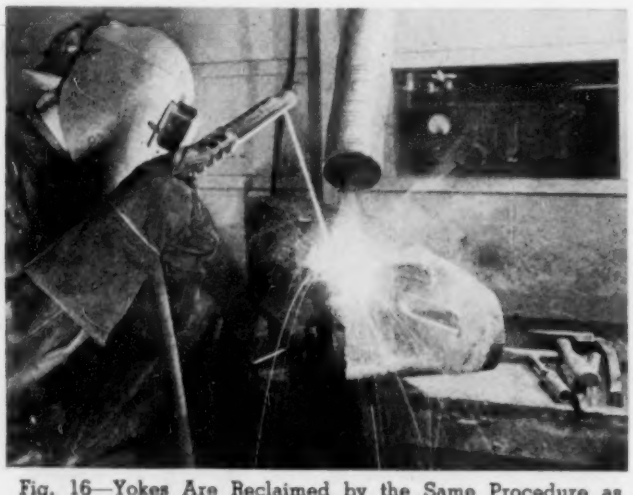


Fig. 16—Yokes Are Reclaimed by the Same Procedure as Couplers. Here a Weld Is Being Deposited in a Veed Crack

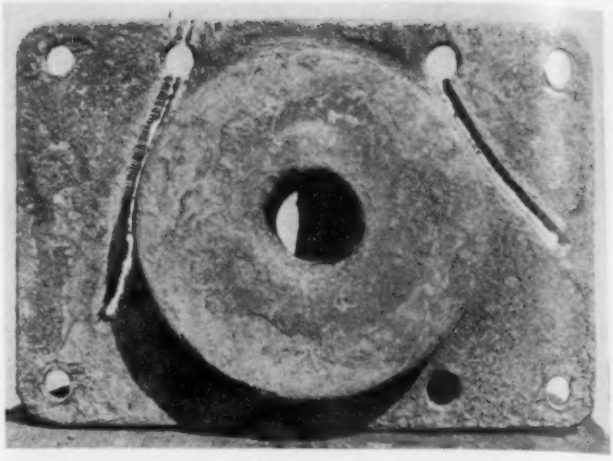


Fig. 17—Freight Car Body Bolster Steel Center Plate Prepared for Welding. One Crack Extended Almost Completely Across the Plate

## Costs

At the time when the advisability of going into coupler reclamation on a large scale was still under discussion I worked up cost estimates based on the work then being done by Erie as compared to the amount of work that could be done under changed AAR regulations, to show the total savings that could be effected by welding. These figures called for a comparatively high initial investment, including the cost of a new heat-treating furnace as well as a separate building in which to do the work, making a total expenditure of approximately $30,000. However, the figures also showed that this investment would be returned in 6 mo., and accordingly our management authorized the expenditure. That these figures were approximately correct has been borne out by cost studies made in actual practice.

Under the old regulations the out-of-pocket cost for making permissible repairs to side-wall cracks and wear in shanks and butts was $2.25, not considering scrap return value. Under the present regulations the additional cost for making unlimited repairs by welding is only $2.40 per coupler, making a total out-of-pocket cost of $4.65. This figure includes all labor costs for inspection, handling, straightening, gouging, finishing of butts, welding, grinding, charging and discharging of furnace, as well as costs for gases, fuel oil, electricity and direct applied overhead. These total costs, when added to the scrap return value of the coupler and compared with the cost of a new coupler, make an average total saving of approximately $15 for reclaiming damaged couplers by welding and normalizing. The bulk of this saving is over and above the savings attainable under the old regulations. On a volume basis the economy of welded reclamation can be seen from the fact that of all the couplers returned from service 80% were reclaimable under the former rulings, which permitted prac-

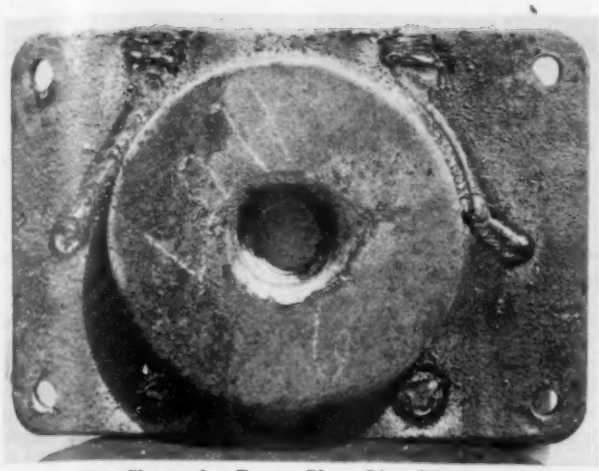


Fig. 18—This Shows the Center Plate After Welding, Prior to Grinding of the Welds

tically no welding except building up. Figure 15, showing freight car couplers banked in the yard awaiting repair, indicates the magnitude of the program at Erie. This accumulation was brought about in anticipation of welding being approved.

### Yokes and Other Parts

Having given a full description of the procedure in repairing cracked and broken couplers, details need not be given on the reclamation of yokes and other parts, since the procedure followed is generally the same. The electric welding of a previously prepared crack in a cast steel yoke is illustrated in Fig. 16. A freight car body bolster center plate in which cracks have been veed for welding is shown in Fig. 17. These plates are mounted on a positioner with strongback clamps to retard warping during welding. The finished plate appears as in Fig. 18 after welding, before the welds have been dressed by grinding.

Another critical part on which welded repairs are made is the truck side frame. As mentioned earlier the Committee on Testing of Side Frames and Bolsters arranged tests in which new side frames were used. These were prepared for testing by making cuts across the tension member about midway between the journal box and the truck column. These cuts were made through 30, 40, 50 and 100% of section, and then welded and subjected to the standard test required of new frames. Four of the specimens passed the side frame test requirements 100%, and the results on the other two were, if anything, even more illustrative of the strength of the welds. When subjected to test these frames showed fractures starting at the junction of the journal box and frame, which was nowhere near the weld in the tension member. The test was then discontinued and these fractures were welded and normalized. The tests were resumed, and this time the frames failed at the other end, at the corresponding points to the first fractures, but again far from the welds. None of the welds failed on any of the specimens and the committee reported favorably on the tests, recommending unlimited welding on side frames and bolsters. With the approval of this recommendation by the AAR, our reclamation plant has been making welded repairs to failed and damaged side frames at the rate of about 50 per month, and there has been no record of failure in service.

### Conclusion

With the body of evidence and experience now available, demonstrating the success of welding and normalizing on highly stressed railroad car parts, there is every reason to believe that this procedure will continue as a standard operation long after the original motives of steel and man-power conservation have ceased to exist as reasons for restoring damaged parts to active service. Wartime shortages have demonstrated that the combined processes of welding and normalizing will produce a repaired part which is at least as safe as the original.

In closing will again repeat that if normalizing is not done and as called for in interchange rules in a properly sealed furnace there will be failures, then it will be blamed on welding.

---

## Current Welding Literature

(*Continued from page 1040*)

Welded Steel Structures. Special Shapes for Welding Designs, W. J. Conley. Steel, vol. 115, no. 2 (July 10, 1944), pp. 88–89, 130.

Welders. Training New Workers at LeTourneau Company's Georgia Plant, G. Hitt. Southern Power & Industry, vol. 62, no. 8 (Aug. 1944), pp. 82–85.

Welding. Arc and Acetylene Welding, H. Kerwin. McGraw-Hill Book Co., New York and London, 1944. 240 pp., illus., diagrs., charts, tables, $2.50.

Welding. Control of Quality Workmanship—III, R. Burnett. Industry & Welding, vol. 17, no. 7 (July 1944), pp. 44, 46, 80.

Welding. How Welding Leads to Improved Design. Sheet Metal Worker, vol. 35, no. 7 (July 1944), pp. 43–44.

Welding. Invasion Welding. Industry & Welding, vol. 17, no. 7 (July 1944), pp. 54–58, 60.

Welding. "Nervous" Welding, L. E. Kunkler. Steel, vol. 115 no. 6 (Aug. 7, 1944), pp. 92, 94.

Welds. Design for Welding, F. W. Sykes. Industry & Welding, vol. 17, no. 7 (July 1944), pp. 62–64, 66–73.

Welds, Ductility. Predicting Welding Conditions, G. E. Doan and R. D. Stout. Iron & Coal Trades Rev., vol. 148, no. 3975 (May 5, 1944), p. 677–678.

Welds. Fatigue Strength of Welded Joints, J. Jones. Elec. Eng., vol. 63, no. 8 (Aug. 1944), pp. 288–290.

Welds, Inspection. Arc Welding Defects and Visual Inspection, W. H. Simon. Can. Machy., vol. 55, no. 7 (July 1944), pp. 101–103; no. 8 (Aug.), pp. 111–112, 114; no. 9 (Sept.), pp. 136, 138, 140, 142.

Welds, X-Ray Analysis. Industrial Radiography, V. E. Pullin. Iron & Coal Trades Rev., vol. 148, no. 3979 (June 2, 1944), pp. 829–831.

Welds, X-Ray Analysis. Low-Powered Radiography of Thin Steel Sections, R. Taylor. Steel, vol. 115, no. 2 (July 10, 1944), p. 110.

# THE AMERICAN WELDING SOCIETY

## ACTIVITIES – RELATED EVENTS

### AMERICAN WELDING SOCIETY RECEIVES ORDNANCE DISTINGUISHED SERVICE AWARD

The Ordnance Distinguished Service award was presented to THE AMERICAN WELDING SOCIETY at its opening session in the Cleveland Hotel, Oct. 16th. The awarding of this honor was last announced last July but the formal presentation was delayed until the Annual Meeting of the SOCIETY being held this week in Cleveland. The citation which Colonel S. B. Ritchie, Assistant Chief of Research and

President Arnott Receives Award from Col. Ritchie

Development, Office of the Chief of Ordnance, read in presenting the award to David Arnott, President of the SOCIETY and Vice-President and Chief Surveyor of the American Bureau of Shipping, was,

> "Ordnance Distinguished Service Award presented to the AMERICAN WELDING SOCIETY in recognition of outstanding and meritorious engineering advisory services, in war and peace, for the development, manufacture and maintenance of ordnance matériel. Award authorized 20 July 1944."

In his remarks before the presentation Colonel Ritchie stated that the Ordnance Department has always been aware of the pre-eminent importance of research and development for national defense and credited the AMERICAN WELDING SOCIETY and the Welding Research Council with playing a vitally important role in helping to put the best weapons to be provided, in sufficient quantities and on time, into the hands of our troops. He discussed various instances of cooperation, including the preparation of an ordnance inspection handbook for metal arc welding, between the WELDING SOCIETY, the Welding Research Council and his department. Colonel Ritchie stated that, "As a result of all this knowledge, we have been able to use welding in production work to a far greater degree than our enemies. Our quality has far surpassed theirs." He also pointed to the fact that the AMERICAN WELDING SOCIETY, in the past 25 years, has grown with welding and was instrumental in bringing welding to the high level of perfection, the results of which have been measured in the firepower, the mobility and the success of welded weapons now on the field of battle.

It is planned to reproduce the certificate of award, the presentation address by Col. S. B. Ritchie and the acceptance by President Arnott in the December issue of THE WELDING JOURNAL.

---

### THE 25th ANNIVERSARY ANNUAL MEETING OF THE AMERICAN WELDING SOCIETY

The 25th Anniversary Annual Meeting of the AMERICAN WELDING SOCIETY held in Cleveland, Ohio, October 16th to 19th will be long remembered by all those who attended.

The registration of 1720 set a record for the short war period meetings. The actual attendance was four or five hundred more than this figure as many members and guests failed to register or were registered by one of the other Societies participating in the Congress.

Undoubtedly the highlights of the meeting were the addresses of Colonel S. B. Ritchie and Mr. Martinsky who presented the address by Admiral Vickery, who was unable to attend because of illness. These addresses portrayed in detail how welding had played an important part in the mass production of ships, tanks, artillery and ordnance matériel in general. High tribute was paid by both of these leaders to the work of the AMERICAN WELDING SOCIETY in bringing the science of welding to a high state of development. The Ordnance Distinguished Service Award was presented by Col. S. B. Ritchie at the conclusion of his address.

The outstanding success of the Annual Meeting was all the more remarkable because of an unusually difficult housing and transportation shortage which confronted the Convention Committee in its arrangements. The Cleveland Section and Headquarters Staff received commendation from the President of the SOCIETY for their efforts.

The technical sessions were well attended and there was standing room only a good part of the time in all of the meeting rooms except in the Ball Room which had a seating capacity of 1000. The papers were of an unusually high caliber for the most part and the discussion brought out many additional points of interest.

---

### CONVENTION WORKERS HONORED

At the Annual Business Meeting of the AMERICAN WELDING SOCIETY President Arnott expressed the appreciation of the SOCIETY on behalf of the workers who contributed to the success of the Annual Meeting. Mr. Arnott's remarks follow:

"To our ever faithful Convention Committee Chairman, Mr. E. V. David, who gave unsparingly of his time for the past year in supervising both national and local activities; to our Treasurer, Mr. Fraser, who stood by to give assistance when needed; our Program Committee Chairman and Secretary, Mr. Vom Steeg and Mr. Spraragen, and members of that Committee for a splendid program; our Publicity Chairman and Secretary, Mr. McDonough and Mr. Stover for laying out and carrying out to completion a well-

At Sections Officers' Speakers Table. Left to right 2nd Vice-President Wendell F. Hess, Incoming President A. C. Weigel, National Secretary M. M. Kelly, President D. Arnott and Treasurer O. B. J. Fraser

# 4,300,000 JOBS TO DO TODAY

**These are busy days for everybody in the telephone business. About 4,300,000 Toll and Long Distance messages go over the lines in the average business day. (That's in addition to more than 100,000,000 daily local conversations.)**

**Most of these millions of messages go through all right but sometimes the Long Distance lines to war-busy centers get crowded. Then the Long Distance operator may ask your help by saying — "Please limit your call to 5 minutes."**

BELL TELEPHONE SYSTEM

planned publicity program; and especially, to our Host Section, Cleveland, its Chairman, Secretary and Past Chairman, Mr. Ross Yarrow, Mr. Les Pfeil and Mr. Bob Kriz, whose experience enabled them to guide the local activities; Mr. Michael Shane, the Registration Chairman, who has not left the premises except at night, so as to make sure nothing was left undone; to Mr. Cal Wyss, who whether present or absent made sure the technical sessions were running smoothly; Mr. Morrill for looking after local publicity matters; and to the individual members of each committee mentioned, we are deeply grateful for an exceptionally well-conducted, successful Annual Meeting."

---

## SOLID PHASE WELDING DESCRIBED AT WELDING SOCIETY ANNUAL MEETING

"Solid Phase Welding" was the subject of the Adams Lecture delivered at the 1944 Annual Meeting of the AMERICAN WELDING SOCIETY by Dr. A. B. Kinzel, Vice-President, Electro Metallurgical Company, and Chief Metallurgist, Union Carbide and Carbon Research Laboratories, Inc., Units of Union Carbide and Carbon Corporation. The Adams Lecture, established at the 1943 Annual Meeting to honor Dr. Comfort Avery Adams, is devoted to the exposition of scientific data bearing on the engineering aspects of some subject in the welding field.

Dr. Kinzel used the term "solid phase welding," to describe the method of joining two structural members in which none of the material is melted at any time during the welding process. A recently developed practical application of this welding process is oxyacetylene pressure-welding, which Dr, Kinzel defined as a process by which "structural members are bonded by atomic forces without the presence of a liquid phase at any stage of the process, comprising pressing together clean, smooth surfaces so as substantially to exclude air, and maintaining suitable pressure while heating to effect bonding." In pressure-welding, an oxyacetylene heating head shaped to conform to the shape of the members being welded is used to heat the abutting ends to the welding temperature.

Dr. Kinzel's paper was concerned principally with the bonding mechanism by which a sound, strong weld is obtained.

Temperature was shown to be the dominant factor in the practical application of solid phase welding. A temperature of 1050° C. appears to be the feasible minimum, with a maximum of about 1200° C., well below the melting point of the lowest melting constituent of the metal.

Successful experiments with the welding of austenitic steels and various brasses were reported. Numerous tests have led to the conclusion that complete interface elimination as determined by the microscope is the best scientific criterion of the quality of a pressure weld although such physical properties as yield strength, tensile strength, elongation and reduction of area are well suited to engineering purposes.

It is planned to reproduce this address in the December issue of THE WELDING JOURNAL.

## PRIZE WINNERS

The following were the winners of the various prizes and medals awarded at the Annual Meeting of the AMERICAN WELDING SOCIETY held in Cleveland, Ohio, from October 16th to 19th.

Wendell F. Hess—The Lincoln Medal for the paper, "Spot Welding of S.A.E. 1020, 1035 and 1045 Steels in the 0.040 Thickness." This paper which was written jointly with Lt. D.C. Herrschaft,

W. F. Hess

# INDEX TO ADVERTISERS


| | |
|---|---|
| Air Reduction Sales Co. | Outside back cover |
| American Brass Company | 1059 |
| American Chain & Cable Company, Inc. | 1010 |
| American Optical Co. | 1083 |
| Ampco Metal, Inc. | 1051 |
| Anti-Borax Compound Company | 1072 |
| Arcos Corp. | Inside front cover |
| Bar-Ray Products, Inc. | 1060 |
| Bastian-Blessing Co. | 1054 |
| Bell Telephone System | 1049 |
| Carnegie-Illinois Steel Corporation | 1067 |
| Chicago Steel & Wire Co. | 1058 |
| Eisler Engineering Co | 1064 |
| Electroloy Co., Inc. | 1070 |
| Eutectic Welding Alloys Co. | 1062 & 1063 |
| General Electric Co. | Insert 1106 & 1107 |
| Harnischfeger Corporation | 1075 |
| Haynes Stellite Company | 1009 |
| Hercules Elec. & Mfg. Company, Inc. | 1052 |
| Hewlett-Packard Company | 1110 |
| Hobart Bros. Co. | 1007 |
| International Nickel Co. | 1081 |
| The Lincoln Electric Co. | 1068 & 1069 |
| The Linde Air Products Company | 1111–1114 |
| Machlett Laboratories, Inc. | 1079 |
| McKay Company | 1087 |
| P. R. Mallory & Co., Inc. | 1073 |
| Metal & Thermit Corporation | 1057 |
| The Midland Paint & Varnish Co. | 1054 |
| National Carbide Corporation | 1074 |
| Nelson Specialty Welding Equipment Corp. | 1089 |
| Oakite Products, Inc. | 1058 |
| Page Steel & Wire Division | 1010 |
| Ransome Machinery Co. | 1108 |
| The Reid-Avery Company | 1077 |
| Resistance Welder Mfrs. Association | 1109 |
| Sciaky Bros. | 1085 |
| Shawinigan Products Corp. | 1060 |
| The Sight Feed Generator Company | 1056 |
| A. O. Smith Corporation | 1065 |
| Standard Machinery Co. | 1053 |
| Una Welding, Inc. | 1091 |
| Union Carbide and Carbon Corp. | 1009 & 1111–1114 |
| United Electronics Company | 1055 |
| United States Steel | 1067 |
| United Welding Company | 1064 |
| Victor Equipment Co. | 1071 |
| Weltronic Company | 1066 |
| Westinghouse Elec. & Mfg. Co. | Inside back cover |
| Wilson Welder & Metals Co. | 1061 |

# FOR PROTECTION against corrosive action of caustics

(or commercial acids)

—fabricate the complete assembly of durable AMPCO METAL and weld with . . .

# AMPCO-TRODE

coated aluminum bronze welding electrodes

This linner tube of ¼" Ampco 15 rolled sheet was welded in 4 sections with Ampco-Trode 10 to form a tube 15" O.D. x 9' long.

## Use this modern method of fabrication where resistance to corrosion is highly essential

If you have a particular assembly or sub-assembly that must resist corrosion, wear, shock, or fatigue, it pays you well in time and money saved—and in increased salability of your product—to fabricate the assembly of Ampco Metal and weld with Ampco-Trode coated aluminum bronze electrodes.

Ampco-Trode is available in five different grades to meet your specific needs. Because it deposits weld metal comparable in strength, ductility, and hardness with the various grades of cast Ampco metal, it is well suited for the particular job illustrated and for almost any combination of dissimilar metals.

Nation-wide distribution enables you to secure Ampco-Trode quickly. Consult your electrode supplier or write us for information.

AMPCO

MAIL THE COUPON

WJ-11

AMPCO METAL, INC.
Dept. WJ-11, Milwaukee 4, Wisconsin

*Please send me Ampco-Trode bulletin, and data on welded assemblies.*

Name.....Position.....

Company.....

Address.....

City.....( ) State.....

U.S.A., was also awarded the prize of $100 given by the Resistance Welder Manufacturers' Association as the best paper coming from a University source. Dr. Hess is a graduate of Rensselaer Polytechnic Institute and received his doctorate from that institution in 1928. He has been connected with the teaching staff of that school since that time and since 1929 has had as a part of his regular duties the teaching of welding to graduates of the United States Naval Academy who have been sent to Rensselaer Polytechnic Institute by the Bureau of Yards and Docks. He has been active in research activities for many years and in 1944 participated in the establishment of research programs under the Office of Production Research and Development of the War Production Board. He is also consultant on welding problems to the American Bureau of Shipping. Dr. Hess has held various elective and appointive offices in the AMERICAN WELDING SOCIETY and has been elected Second Vice-President for the year 1944–45.

Donald C. Herrschaft—same prize awards as Wendell F. Hess. Lt. Herrschaft is a graduate of Rennselaer Polytechnic Institute, class of 1942, having received his degree in metallurgical engineering. He remained at that school on an Institute of Research Fellowship until October of 1942 when he enlisted in the United States Army Air Forces. He is now Base Weather Officer at the Base Weather Station, Childress AAF, Childress, Texas.

Lt. Donald C. Herrschaft

Reginald B. Bland—awarded the prize of the Resistance Welder Manufacturers' Association for the best paper coming from an industrial source. The paper was titled, "The Dynamic Properties o Flash-Welded Tubing," and was written jointly with P. E. Sandorff. Mr. Bland received his engineering training at the California Institute of Technology and is now Senior Research Engineer with the Lockheed Aircraft Corporation.

R. B. Bland


WELDERS — SHIP FITTERS — PLATE FABRICATORS —

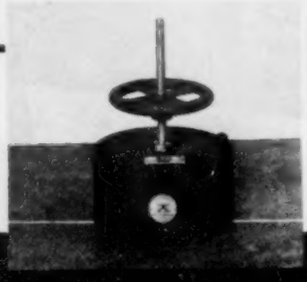
SPEED WELDING OPERATIONS

SAVE TIME, LABOR AND MATERIALS WITH

HERCO MAGNETIC ALIGNERS

Herco Aligners magnetically true-up and hold firmly in welding position, plates, beams, rods . . . eliminate time-consuming manual aligning, welding of temporary clamps, wedges or use of heavy weights to hold in position the parts to be welded. Hooked up to either AC or DC power, Herco Magnetic Aligners do the work normally required of a full man crew . . . in almost no time and with precise efficiency.

Herco Aligners are simple to operate, easy to handle and have a magnetic pull of 2,000 pounds per surface inch on one inch plate. Further details will gladly be sent on request.

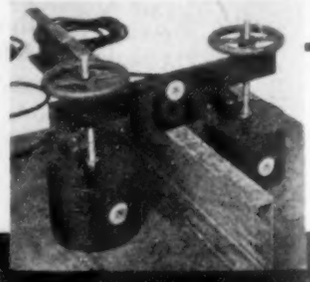


ALIGNING BUTT END PLATES FOR TACK WELDING

A Herco Aligner is placed squarely on the seam and when energized instantly draws both plates flush against the perfect surface of the magnet, thereby trueing up areas on both sides for tacking.

BUCKLING ELIMINATED BY PRESSURING STIFFENER BEAM

Shipbuilding requires reinforced stiffener beams across each plate at stated intervals. Warped plates are quickly positioned for welding to the stiffener beam by placing the aligner as illustrated.



HERCULES ELECTRIC & MFG. CO.

INCORPORATED

2416 ATLANTIC AVENUE ★ BROOKLYN 33, N. Y.

DC and AC WELDERS • TRANSFORMERS • MAGNETIC CLAMPS • SOLENOIDS • RIVET HEATERS

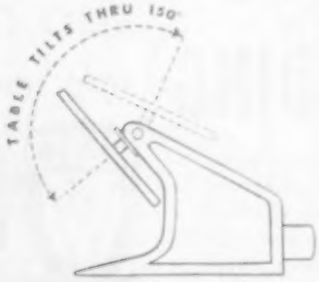
SPOT WELDERS • FLUORESCENT BALLASTS • SPECIAL CONTROLS

# "Standard"
# WELDING POSITIONER

## *New* EFFICIENT • ECONOMICAL

Designed to rotate work up to 700-lbs. at speeds from 0 to 1.9 RPM in either direction by easy hand wheel control. Linear speeds at all radii are easily set and indicated on chart above hand control wheel. For sequence or step welding, table may be positively started and stopped.

The new built-in "Standard" Variable Speed Transmission and hydraulic cylinder provide definite power control with a single ½ HP, 110 or 220 volt electric motor. There are no belts or clutches. The rotation of the table is started, stopped and reversed by foot pedal and hydraulically power tilted by manual lever control. An elevating screw provides adjustment of floor to table height between 30″ and 36″.




The mechanism of the "Standard" Positioner is enclosed entirely for safe operation. There are no exposed gears.

*Write for latest information.*

**STANDARD MACHINERY COMPANY**

**1471 Elmwood Avenue, Providence 7, R. I.**

Paul E. Sandorff

Paul E. Sandorff—joint winner with Reginald B. Bland. Mr. Sandorff received his degree in Aeronautical Engineering from the Massachusetts Institute of Technology in 1939 and has been associated with the Lockheed Aircraft Corporation since that time as a Senior Research Engineer in matters dealing with material properties, test methods, instrumentation and practical applications of the theory of structures.

F. T. Llewellyn—awarded the Samuel Wylie Miller Memorial Medal and Certificate for his contributions to the structural welding field. Mr. Llewellyn, now retired, is former Director of Research for the United States Steel Corporation.

---

## MILLER MEDAL AWARDED TO F. T. LLEWELLYN

At the opening session of the Annual Meeting the 1943 Miller Medal was awarded to Mr. F. T. Llewellyn by Mr. F. H. Frankland, consulting engineer. In the absence of Mr. Llewellyn the medal was received by Mr. Milton Male, a former associate of Mr. Llewellyn who read Mr. Llewellyn's acceptance remarks.

### Presentation Address by Mr. F. H. Frankland

This award of the Samuel Wylie Miller Memorial Medal to Frederick Thomas Llewellyn fittingly recognizes his many invaluable contributions to the development of structural welding. Beginning some years before his presidency of the AMERICAN WELDING SOCIETY during 1928 to 1930, these contributions, on many occasions, provided the impetus required in seeking the truth. His clear and logical thinking applied to welding research developments did much to guide such research in the right channels.

Mr. Llewellyn's qualitative judgments, based upon many years' experience, were expressions which served as a guide to many of his colleagues and co-workers. He possesses a clear and thorough understanding of the influence of human nature on science, and a highly developed scientific conscience, which is aptly illustrated by the quotation from Francis Bacon which he caused to be printed on the flyleaf of the 1931 Report of the Structural Steel Committee of the Bureau of Welding, reading—"If a man will begin with certainties, he shall end in doubts, but if he will be content to begin in doubts, he may end in certainties." This mental attitude toward scientific research is one that we all would do well to emulate.

All those who knew Mr. Llewellyn and were associated with him in his important contributions to the development of welding will applaud this well-merited recognition of his work.

I feel it an honor and a great pleasure to act as the representative of the SOCIETY in this bestowal of the Samuel Wylie Miller Memorial Medal and Certificate to past-president Frederick Thomas Llewellyn.

### Response by F. T. Llewellyn

In acknowledging the deep appreciation with which this award of the 1943 Samuel Wylie Miller Memorial Medal and Certi-


FREE

ENGINEERING INFORMATION *for* BETTER WELDING

This New Engineering Bulletin contains important technical information that may save you time, labor and money on many welding jobs. Learn how to keep welding jigs free of spatter; how to save mill-scale cleaning time after normalizing; how to reduce fumes; etc. etc. Contains actual case histories and laboratory authenticated reports. Write for your copy now.

WELDING SUPPLY DISTRIBUTORS AND SALESMEN WANTED

*The* MIDLAND PAINT & VARNISH CO.

9126 RENO AVENUE CLEVELAND 5, OHIO

BRASS MAKES BULLETS

REGO Gas Plant Equipment to be safe, must be made of brass and other critical metals. Conserve your equipment. You may not get more.

The BASTIAN-BLESSING Co.

4241 W. PETERSON AVE. CHICAGO

Pioneers and Manufacturers of Precision Equipment for Using and Controlling High Pressure Gases

# Obvious Quality

## VISUAL

Clean cut mechanical nicety literally radiates from these UNITED mercury rectifiers. It is only natural that their eye appeal impresses the exacting minds of so many government and commercial engineers.

## TEST

The physical ruggedness and sterling workmanship in these tubes reveal the kind of care and precision that has entered into the electrical phases of their design. They are criterions, rather than ordinary conformers to the constantly stiffening Army and Navy test specifications—both mechanical and electrical.

## SERVICE RECORDS

Representative service records maintained over a period of 10 years by large users prove an average of many thousands of hours satisfactory operating life.

THERE IS NO SPECULATION IN CHOOSING UNITED MERCURY RECTIFIERS

# UNITED
## MERCURY RECTIFIERS

The UNITED types illustrated will interchange with and replace other type tubes as follows:

USE UNITED TYPE 967 to replace FG-17
" " " 972-A " " 872-A
" " " UX-973
" " " 973 (Not illustrated) "873"

UNITED ELECTRONICS COMPANY • NEWARK 2, N. J.

Transmitting tubes exclusively since 1934

ficate is accepted, one's thoughts are irresistably impelled toward the man in whose memory the award was established, rather than the things attempted by the present recipient, or the results for which he is now so kindly credited.

The early days of the AMERICAN WELDING SOCIETY are recalled, when many differing views emerged both as to the objects of the SOCIETY and the reaction of normally competitive interests.

Although a score of years have not elapsed, in retrospect the figure of Sam Miller still stands forth among the leaders in promoting unity of effort as a means to the final success of all. With perhaps only a smile here, and a quiet word there, he set an *example* of unselfish cooperation which did much to transmute possible conflict into that spirit of good-fellowship which now so happily characterizes the organization.

The presently honored medalist is indeed proud and thankful to be thus linked, even at a distance, with his old friend, Samuel Wylie Miller, in the records of the SOCIETY.

## SECTIONS HONOR MISS KELLY

In connection with the 25th Anniversary of the AMERICAN WELDING SOCIETY and her service with the Society during that period, Miss M. M. Kelly, National Secretary of the SOCIETY, was presented with a handsome silver tray suitably engraved, 25 silver dollars, and a $500 War Bond. Presentation was made by Mr. George N. Sieger, Chairman of the National Membership Committee, on behalf of the Sections at the Section Officers Conference.

**Mr. Sieger Presents National Secretary M. M. Kelly Tokens of Appreciation of the Sections of A. W. S. for Her 25 Years of Service with the Society.**

A real Hawaiian Lei was sent by Air Mail by the Hawaiian Section and placed on Miss Kelly in true Hawaiian style by Mr. Allen Renton of the Hawaiian Section.

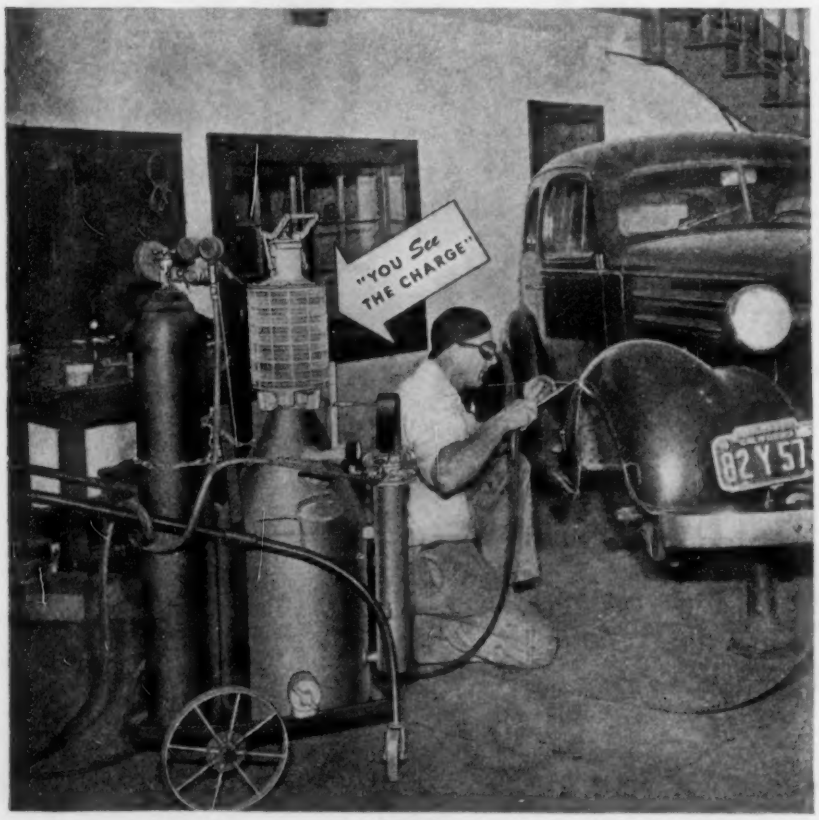
## A.S.M.E. RECEIVES DISTINGUISHED SERVICE AWARD

Major General L. H. Campbell, Jr., Chief of Ordnance, has notified the American Society of Mechanical Engineers that it has been honored with the Distinguished Award of the Ordnance Department, "in recognition of scientific and engineering achievement," particularly in connection with the war effort.

Robert M. Gates, President of the Society, has expressed to the Department "high appreciation of this award for our service to Army ordnance. Our Society, like the engineering profession generally, is gratified that engineers have had extraordinary opportunity, on both the fighting fronts and the production fronts, to contribute to the victory now in sight." He added that the Society now turns its eyes to the future to meet the responsibility of setting an example to the younger men in its membership to do an even bigger and better job in the future in cooperation with the Ordnance Department.

## A.S.T.M. RECEIVES ORDNANCE DISTINGUISHED SERVICE AWARD

At a special meeting of the American Society for Testing Materials in Philadelphia on October 12th, Major General G. M. Barnes, Chief, Technical Division, Army Ordnance Department, presented to the Society the Ordnance Distinguished Service Award, this having been authorized some weeks earlier. President P. H. Bates, National Bureau of Standards, received the award for the members; preceding the special meeting there was an informal dinner with local ordnance offi-

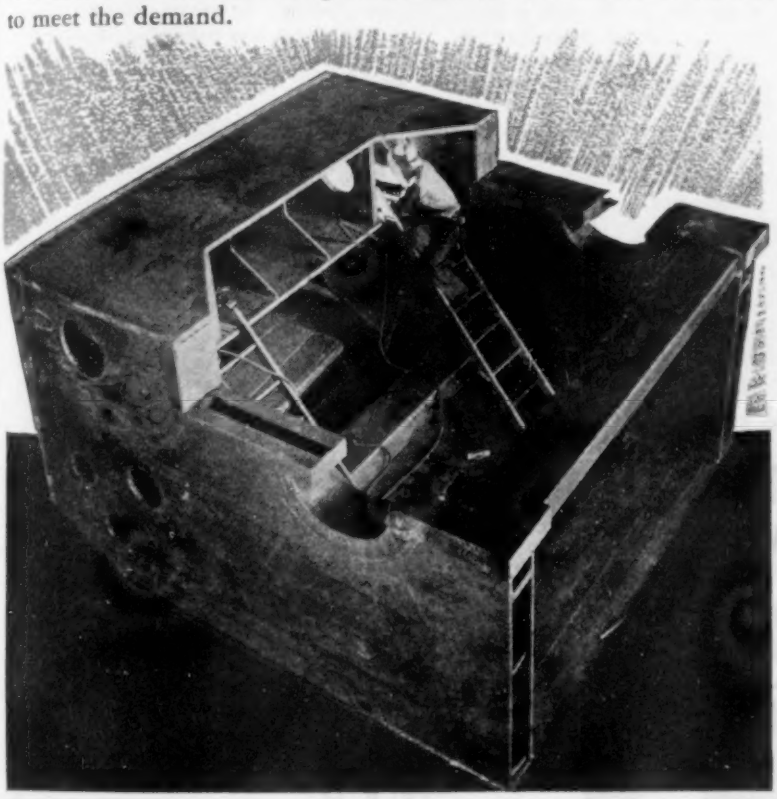

*The Best Old Car in the World?*

Naturally, we wouldn't single out one hard-worked vehicle and label it the finest in the world. But we do contend, age and usage considered, America's cars, trucks and buses have more stuff left in 'em than those of any other nation. Sincere tribute to American manufacturing methods? Yes, definitely! *And to our repairmen and equipment, as well . . .* not the least of which is the Sight Feed Acetylene Generator, giving purer, hotter acetylene gas for welding at savings up to 75%. Write today for complete information about this famous acetylene source that is helping keep America's transportation system hale and hearty and on the roll.

THE *Sight Feed* GENERATOR COMPANY • SALES: RICHMOND, IND. • FACTORY: W. ALEXANDRIA, O.

**THE POSTWAR WORLD** is going to see the production of many new, high-strength alloy steels. This means new arc welding electrodes to meet the new metallurgical requirements.

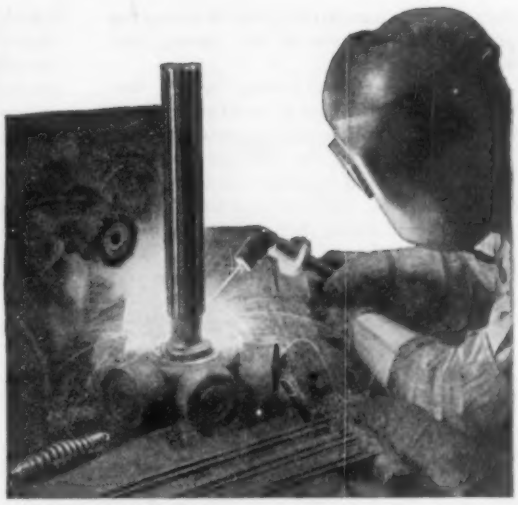
As in the past, Metal & Thermit intends to be ready and whenever one of these new rods is required, there will be a Murex Electrode to meet the demand.



**HUGE BENDING PRESSES,** manufactured by The Cleveland Crane and Engineering Company, have bending capacities up to 220 tons. All-welded frames, fabricated with Murex Electrodes, have greater strength and rigidity for weight of metal used than is possible by any other method. A feature of the design is that distortions and strains are not concentrated but are absorbed by frame as a whole.

**WHEN WORK** cannot be positioned and where welds of good quality must be made overhead, specify Murex Vertex Electrodes. A combination gas and slag shielded rod, Vertex induces flat or slightly convex fillets. Uses D.C., reverse polarity.

Send for your copy of the new Murex Wall Chart, a guide to the right electrode to use for the job. Also contains application data and physical properties.



**THIS COUPLING SHAFT,** used by Caterpillar Tractor Co. in a running-in stand for testing Diesel engines, is subject to extreme tension and torsional stresses. In case of breakage, it is repaired with Murex Electrodes because of the high tensile strength and excellent physical properties of the weld metal.

**CRAWLER FRAMES** of high speed tractors are welded with Murex Genex Electrodes by International Harvester Company. Positioning enables the frames to be tilted to the most advantageous angle for each operation.

**MUREX**

**ARC WELDING ELECTRODES**

•

**METAL & THERMIT CORPORATION**

120 Broadway, New York 5, N. Y.

ALBANY • CHICAGO • PITTSBURGH
SOUTH SAN FRANCISCO • TORONTO

*Specialists in welding for nearly forty years. Manufacturers of Murex Electrodes for arc welding, and of Thermit for repair and fabrication of heavy parts.*

cials and representatives from Washington present with officers of the Society and local members.

In tendering the award, which was made, "In recognition of outstanding and meritorious engineering advisory services, in war and peace, for the development, manufacture and maintenance of Ordnance matériel," General Barnes stressed the great uniformity, reliability and quality which ordnance matériel must have, the quality being insured by proper and adequate specifications.

## A.F.A. BOARD ELECTS STAFF OFFICERS

Officers of the American Foundrymen's Headquarters Staff were elected for the coming year at the recently held annual meeting of the Association's Board of Directors, held in Chicago, July 11th to 13th. At the same time the Directors created a new Technical Development Program for the purpose of expanding the technical activities of the organization.

Staff officers elected were as follows: *Secretary*, R. E. Kennedy; *Director of the Technical Development Program*, N. F. Hindle, formerly Assistant Secretary; *Treasurer*, C. E. Hoyt; *Assistant Treasurer*, Miss Jennie Reininga; *Business Manager*, Wm. W. Maloney, formerly Assistant Secretary.

In broadening the Association's technical scope, the Technical Development Program will operate in accordance with the fundamental objectives already established. Its functions, in the main, will include: (*a*) revision and publication of special books and pamphlets on specific phases of foundry practice; (*b*) collection, review and correlation of published and unpublished data; (*c*) promotion and coordination of investigations now being carried on by the association; (*d*) establishment and development of broader library facilities; (*e*) establishment of broader abstract and bibliographic services; (*f*) development of material for presentation before association chapters and other engineering and technical groups.

## NEW WELDING FILM

"New Horizons in Welding" is the title of a 16-mm. sound film just released by the Harnischfeger Corp., Milwaukee, Wis. A 30-min. presentation, it deals primarily with the setup for production welding, picturing the step-by-step procedure followed where welding is used on a high-speed, mass-production basis. It is not only the first complete story on the subject to reach the screen, but it serves to educate in the methods used to cut costs and speed production in modern fabrication of metal products. According to M. H. Rutishauser, Manager of the P&H Welding Division, the film will be available to all interested groups—manufacturers, trade schools, government departments, etc.

### Welding at Its Best

As all-welded fabrication represents the ultimate in welding applications, the camera moves behind the scenes in a large manufacturing plant where "all-welded" applies to some 10,000 different items. Here you see the experimental laboratories, where various metals and electrodes undergo rigid tests to determine which are best suited together.

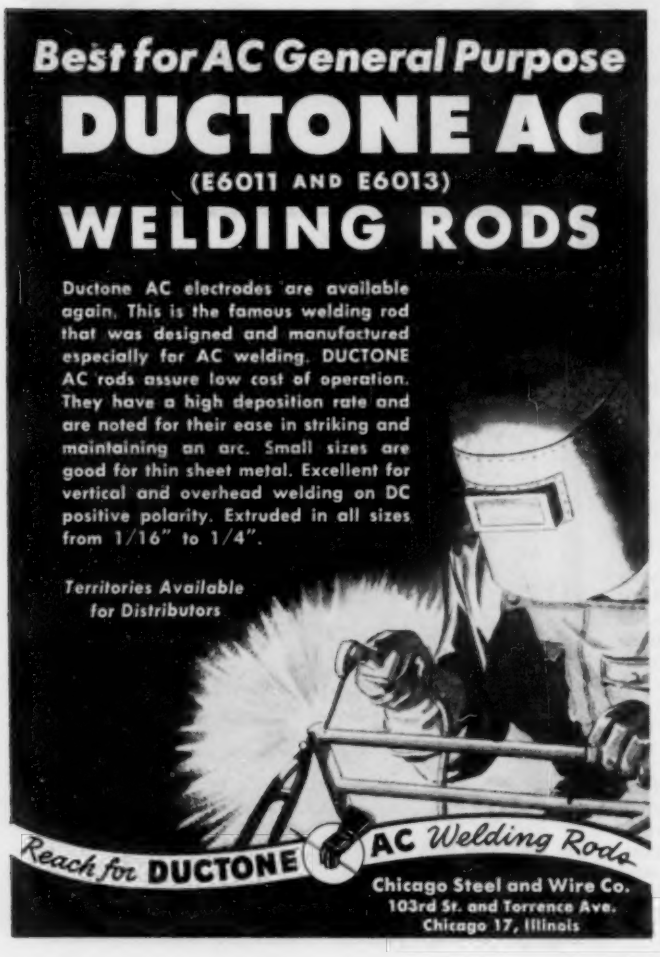
Here, too, is the template department, whence come the patterns that serve as a guide for every product, from start to finish. Next, the lens focuses on the setup man, key figure in the production welding scheme. It is he who does most to simplify the job, assembling parts so that nothing remains for the production welder but the routine application of metal.

Many other devices are revealed as time and labor savers, among them cranes, hoists and welding positioners that permit work to be tilted or turned to suit the welder's convenience. Selection of the proper current for any given weld is completely visual, and reduced to the simplest form by the single heat control on welding machines.

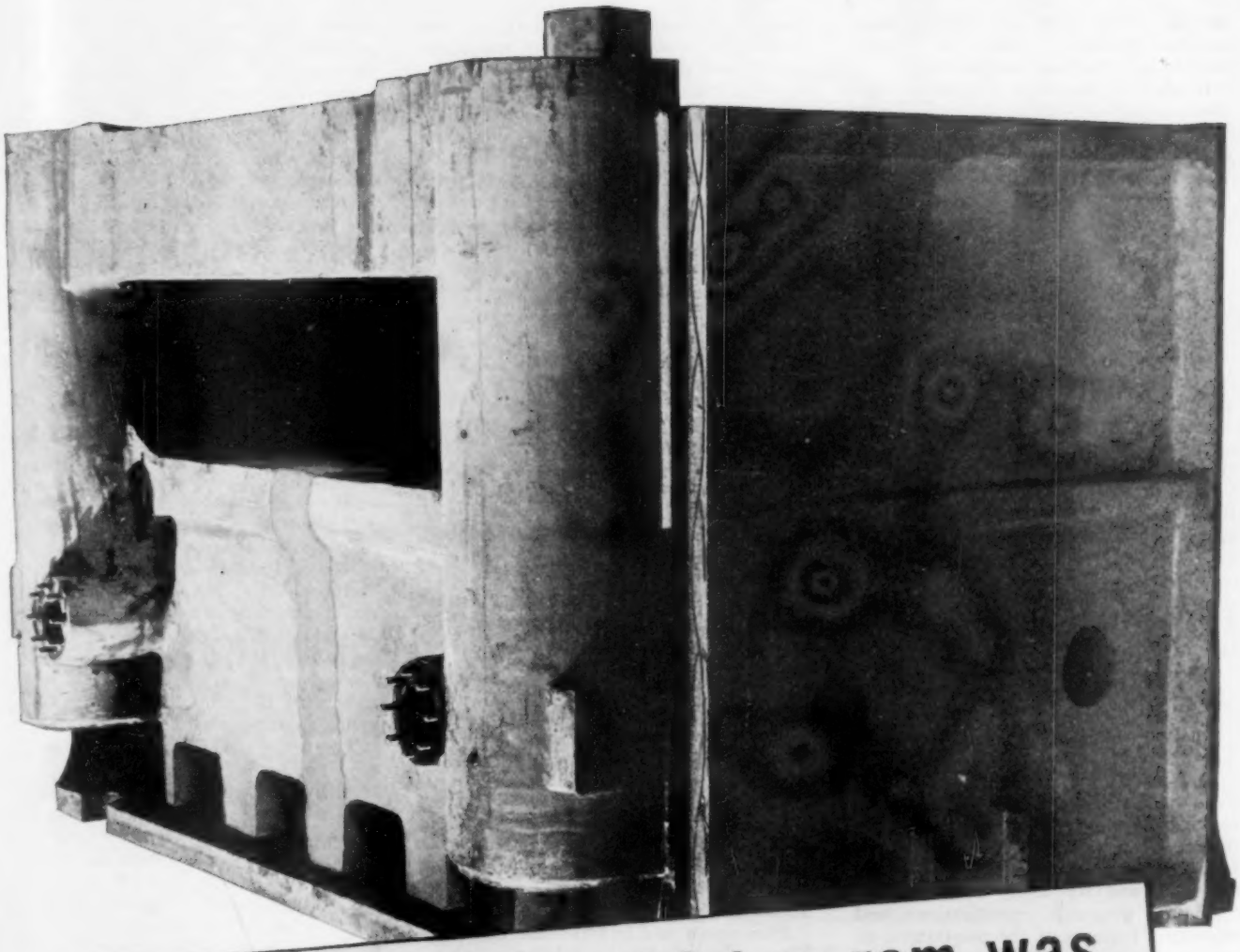
### Arc Timer Latest Innovation

One of the important contributions of "New Horizons in Welding" is its portrayal of the new arc timer in action. Here is the device that makes it possible to achieve positive control of production welding—control of costs, procedure, production and quality.

A definite arc time is established for every job, and each man is paid for the time he is actually depositing metal. Thus



Best for AC General Purpose
DUCTONE AC
(E6011 AND E6013)
WELDING RODS
Ductone AC electrodes are available again. This is the famous welding rod that was designed and manufactured especially for AC welding. DUCTONE AC rods assure low cost of operation. They have a high deposition rate and are noted for their ease in striking and maintaining an arc. Small sizes are good for thin sheet metal. Excellent for vertical and overhead welding on DC positive polarity. Extruded in all sizes from 1/16" to 1/4".
Territories Available for Distributors
Reach for DUCTONE AC Welding Rods
Chicago Steel and Wire Co.
103rd St. and Torrence Ave.
Chicago 17, Illinois

Is this YOUR Cleaning Problem?
Surface Preparation of Alclad for Spot Welding
Uniformity and strength of spot welds on Alclad depend to an important degree on correct surface preparation.
A NEW Special Oakite Service Report describes techniques successfully used in leading aircraft plants, gives all essential details and advantages that result by using specially designed Oakite cleaning materials for this work. Your copy of this valuable Service Report is FREE for the asking.
OAKITE PRODUCTS, INC., 18E. Thames St., NEW YORK 6, N.Y.
Technical Service Representatives Conveniently Located in All Principal Cities of the United States and Canada
OAKITE CLEANING
MATERIALS METHODS SERVICE



# In 72 hours this 24-ton ram was repair-welded with TOBIN BRONZE

A large hydraulic press was busily engaged in the war production work of a well-known manufacturer, when this 14-ft. x 8-ft. x 8-ft. ram broke. Next day it was sent to the Super Arc Welding Company, Detroit, Mich. for repair. Just 72 hours later the press was back on the job forming aircraft parts. Ten welding operators and four helpers, working in shifts, had used some 750 pounds of Tobin Bronze* Welding Rod to restore the broken internal ribs and front face of this expensive piece of equipment.

This is another example of the outstanding wartime repair welding being done with such rods as Tobin Bronze and Anaconda 997 Low Fuming. Their worth is emphasized today when prolonged equipment life is so important. Publication B-13 gives full details—copy on request. 4370

*Reg. U. S. Pat. Off.

**KEEP BUYING WAR BONDS REGULARLY**

ANACONDA

## Anaconda Welding Rods

THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut

*Subsidiary of Anaconda Copper Mining Co.* • In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

the arc timer rules out inferior work, either in quality or quantity, yet it lends itself to any system of compensation.

Readers interested in exhibiting "New Horizons in Welding" or in learning more of its contents should address the Harnischfeger Corp., Welding Division, 4400 West National Ave., Milwaukee 14, Wis.

### A.S.A. ORDNANCE AWARD

At a luncheon at the Waldorf Astoria in New York City, the Army Ordnance Department presented its Distinguished Service Award to the American Standards Association "In recognition of outstanding and meritorious engineering advisory services in war and peace, for the development, manufacture and maintenance of Ordnance matériel."

General Stewart E. Reimel, recently returned from active service in the Pacific War Theater, made the presentation before representatives of the 80 national trade, technical and governmental groups that make up the membership of the A.S.A., and some of the men who have taken a leading part in the technical work.

### POSITIONING EQUIPMENT

Bulletin No. 2551, presenting in concise form the full line of Ransome welding and assembly positioning equipment, has been released by Ransome Machinery Co., Dunellen, N. J., a subsidiary of Worthington Pump and Machinery Corp.

Photos, diagrams, specifications and important features of the positioners, as well as load rating tables, are included in the handy 4-page, 2-color bulletin. Copies may be obtained by addressing the company.

### DROP FORGINGS

How "hot working" improves quality of metal is described and illustrated in a 40-page booklet issued recently by the technical committee of the Drop Forging Association, 605 Hanna Building, Cleveland. It is intended for users of forgings, instructors in engineering and metallurgy, designing engineers, metallurgists, and production and management executives throughout the metal-working industry.

First dealing broadly with characteristics of forging materials, the booklet features steel, and in a not-too-technical language and also by means of more than 200 halftones and diagrams gives a clear understanding of how this metal gains in strength and toughness, step by step, progressively through hot-working operations from ingot to finished forging.

### WELDED SEAPLANE MOORING BIT

In the manufacture of a seaplane mooring bit assembly, the adoption of spot welding reduced the operation from $2^1/_2$ hr. to $^1/_2$ hr., at the Glenn L. Martin Co. Baltimore plant.

Riveting had previously been used, and the impact attendant to this method tended to distort the tube which had to be perfectly round in order to fit into the mooring bit socket on the plane. Aluminum rivets, substituted for steel, did not correct the trouble. Every conceivable method of rectifying the distortion caused by riveting was tried to no avail.

Spot welding answered the problem. Distortion was eliminated and the spot weld proved to have four times the shear strength of an aluminum rivet.

This case was an interesting one in that it presented a problem of attaching a thick, rough casting to a comparatively thin-walled tubing. Special electrodes and a heat control sequence were necessary to accomplish an effective weld.

Here was a case in which the Glenn L. Martin Co. called on its welding engineers for the solution.

### SHOT PEENING AND THE FATIGUE OF METALS

The result of many months' laboratory research, a study titled "shot Peening and the Fatigue of Metals," by H. F. Moore, for many years Research Professor of Engineering Materials at the University of Illinois, has been published by American Foundry Equipment Company, 555 S. Byrkit St., Mishawaka, Ind. Among the subjects covered are: Types of structural damage of metals, how shot peening increases resistance to plastic distortion, the origin of fatigue cracks, the effects of cold working, measurement of shot peening intensity, examples of increased fatigue life from shot peening, and many others. The booklet is illustrated by microphotographs, charts and tables, and contains research data never before published.

### IMPORTANT NEW ACTIONS ON STANDARDS BY THE AMERICAN SOCIETY FOR TESTING MATERIALS

*Steel.*—The four new standards developed by Committee A-1 on Steel cover carbon-steel and alloy-steel blooms, billets and slabs for forgings, and methods of magnetic particle testing and inspection of heavy forgings and commercial steel castings. The so-called billet specifications include considerable material not heretofore included; they also bring up to date the list of chemical compositions covered. An emergency provision goes with the alloy billet specifications giving a complete list of the N.E. steels.

Two of the steel committee groups have been conducting an intensive study on standardized technique, and recommendations for magnetic particle testing, and various technologists representing producers and consumers have reached decisions on a number of conflicting points. Eventually the steel committee hopes to issue a so-called monograph on this method of testing with specification practices applicable to various steel products.

Intricacies of forgings, castings and methods of evaluating defects have prevented the inclusion of any specific acceptance or rejection standards.

Among numerous revisions in steel standards are some affecting the austenitic or stainless alloys in the pipe and tubing field and projected changes in the commercial bar specifications, both hot rolled and cold rolled where eventually revised chemical compositions will be given and there will be added as information data on physical properties and suggestions on appropriate uses of the various grades.


BAR-RAY
BROOKLYN NEW YORK

X-RAY AND GAMMA-RAY PROTECTION

AMONG THOSE WE SERVE!

Martin Bomber • Fairchild Aviation • Brooklyn Navy Yard
Eclipse Aviation • Bethlehem Steel • U. S. Agencies and
Bell Aircobra • Picatinny Arsenal War Plants

BAR-RAY PRODUCTS, INC.
Plant and Mill: 209—25th STREET, BROOKLYN 32, N. Y.
TEL: SOuth 8-5225 • AGENCIES IN PRINCIPAL CITIES

Time Counts—
Gas cut and Weld with
Shawinigan Carbide

SHAWINIGAN

SHAWINIGAN PRODUCTS CORPORATION
EMPIRE STATE BUILDING, NEW YORK 1, N.Y.

# Better Welds

## *Low Temperature*

# WELDING RODS

**EUTECTIC welds are: SMOOTHER • STRONGER • BETTER COLOR MATCHED • MORE MACHINABLE • FASTER TO MAKE and REQUIRE LESS HEAT, avoiding distortion, stresses and overheating**

No other welding or brazing process affords welders such a combination of advantages at such low bonding temperatures (as low as 340°) and little heat consumption.

Metallurgists and welders have long been aware of the tremendous advantages welding at *Low Temperatures* would have in metal joining. If it were possible to gain the advantage of the strong bond formed by fusion welding without resorting to high temperatures, the ideal in welding would be achieved and an all-round better weld obtained.

EUTECTIC *Low Temperature* Welding, the most revolutionary welding development of modern times, enables you to weld joints at temperatures *below the fusion points of base metals*—eliminating the many hazards of high temperature fusion welding.

All metals can be joined by the EUTECTIC process. No special skill is required . . . no extensive training needed. All standard methods of heating are employed: Gas—Arc—Furnace and others in combination with the new EUTECTIC Welding Rods and Fluxes.

***Get the facts today! Fill in the coupon or write on your company letterhead for full information.***

*Castolin Eutectic*

**EUTECTIC WELDING ALLOYS COMPANY**
Originators of Eutectic *Low Temperature* Welding
40 Worth Street, New York 13, New York

EUTECTIC WELDING ALLOYS COMPANY
40 Worth Street, New York 13, New York Room 1110F

Please send me full information about EUTECTIC *Low Temperature* Welding and its many great advantages.

Name_____

Company_____ Position_____

Address_____

City_____

## A.S.T.M. ADVANCES BY FULL YEAR PUBLICATION OF ITS BOOK OF STANDARDS

Heavy demands for the 1942 Book of A.S.T.M. Standards and its Supplements occasioned by the war production efforts have necessitated advancing by a full year publication of the next book. Normally this would come out in November–December 1945 on the triennial basis, but the Book will be issued in December 1944.

Very widely used by American industry and many branches of state and federal governments, this book providing authoritative specifications and tests for a wide range of engineering materials, will cover some 6000 pages in three parts: I, Metals; II, Nonmetallic Materials—Constructional (cement, lime, concrete, paint, etc.); Nonmetallic Materials—General (petroleum, textiles, plastics, coal, rubber, etc.).

---

## CHEMICAL ANALYSIS OF METALS

The only book providing these widely used analytical procedures—gives all of the 21 A.S.T.M., methods including the extensive chemical methods of analysis of steel, cast iron, open-hearth iron and wrought iron, all of the A.S.T.M. methods of analyzing ferroalloys (3) and nonferrous metals and alloys (11). Also three methods of quantitative spectrochemical analysis; proposed standard methods on bronzes and special brasses, and on lead and tin-base bearing metal are published as information. New recommended practices for apparatus and reagents for chemical analysis of metals are important additions. 340 pages. August 1943. Cloth binding $3.00.

---

## AMERICAN WAR STANDARD SPECIFICATIONS FOR PROTECTIVE OCCUPATIONAL (SAFETY) CLOTHING

The Safety Code Correlating Committee has recommended approval of six war standard specifications for Protective Occupational (Safety) Clothing as shown below.

The War Committee on Protective Occupational Clothing has developed these proposed war standards under authority of the chairman of the Standards Council. A letter from the chairman of this war committee was circulated to all members of Standards Council in MC2118.

The proposals were sent to letter ballot of the Safety Code Correlating Committee (29) members with the following results: 26 affirmative ballots, 0 negative ballots, necessary for approval 25.

In accordance with the recommendation of the Safety Code Correlating Committee, as chairman of the Standards Council, H. S. Osborne has approved the six specifications for Protective Occupational Clothing with the following A.S.A. designations:

Welders' Leather Gauntlet Gloves—L18.7-1944.
Protective Leather Gloves, Steel Stapled—L18.8-1944.
Asbestos Gloves—L18.9-1944.
Asbestos Gloves, Leather Reinforced—L18.10-1944.
Asbestos Mittens—L18.11-1944.
Asbestos Mittens, Leather Reinforced—L18.12-1944.

---

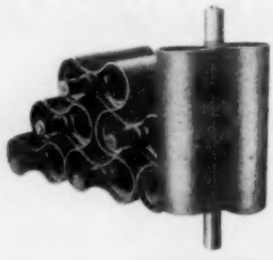
## NEW HARD-FACING PAMPHLET

A new pamphlet entitled "Cut Costs with Haynes Stellite Hard-Facing Rods" is available from Haynes Stellite Co., a Unit of Union Carbide and Carbon Corp., in single copies for interested individuals, or in quantity for distribution by welding shops to their customers.

This attractive pamphlet explains the advantages of protecting wearing parts by hard facing with Haynes Stellite alloy, lists typical parts that can be hard faced in various industries and illustrates some of these parts.

Samples of the pamphlet or further information on obtaining stocks of it may be obtained from Haynes Stellite Co., Kokomo, Ind.

---



IN REGULAR PRODUCTION AT UNITED WELDING

ARMY E NAVY

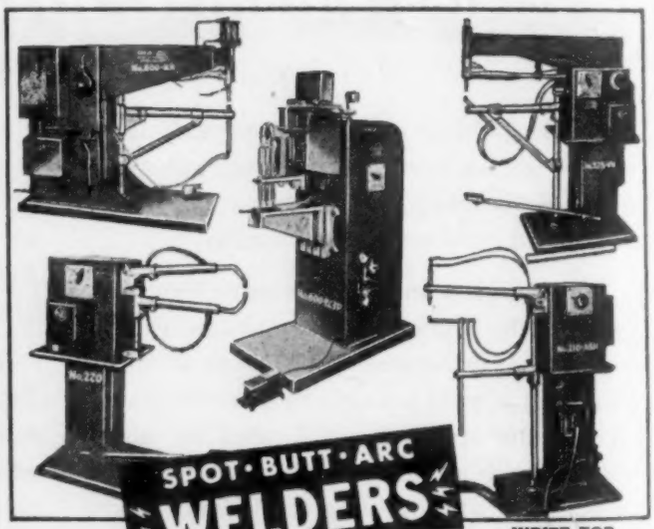
Blower impellers, like those above . . . field rings like those below . . . are today regular "grist for our mill." That is war production. Soon, let us hope, things of a more peaceful nature will take their place.

You, no doubt, have or soon will have, products to market. Those products may be of a design that would gain through welded construction . . . for style . . . for strength . . . for lightness . . . to make them less costly to produce. If so, our engineers and our facilities can serve you to advantage.

Let us look at your drawings. Confidential of course. Get our quotations.

WELDING ENGINEERS · UWCO · MIDDLETOWN, OHIO

THE UNITED WELDING CO.
MIDDLETOWN, OHIO
WELDING FABRICATORS OF MODERN DESIGNS



SPOT · BUTT · ARC WELDERS

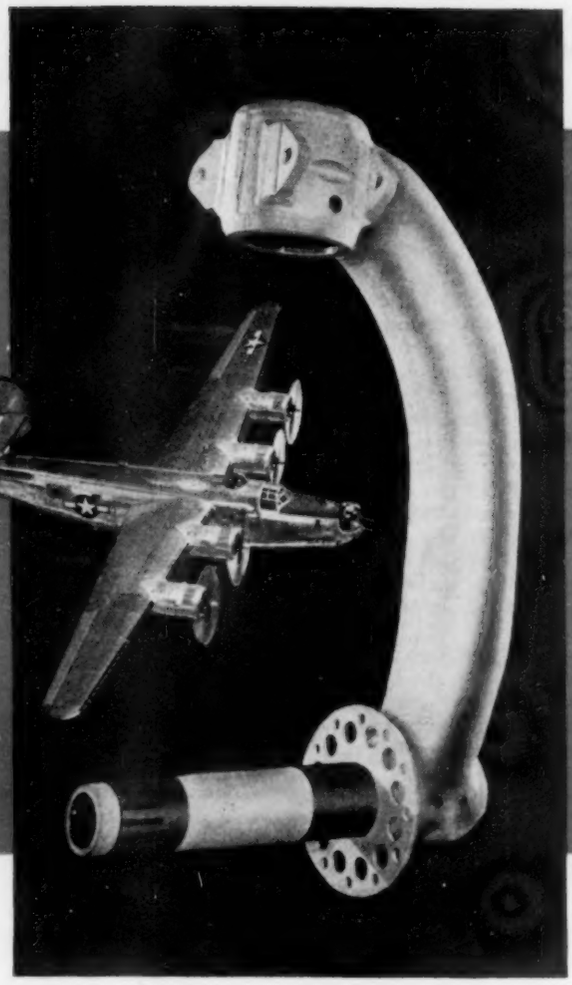
WRITE FOR CATALOG

We manufacture a complete line of resistance spot welders from ¼ to 300 KVA for all types of welding. There is an EISLER WELDER for every purpose.

TRANSFORMERS OF ALL TYPES

WE INVITE CONTRACT SPOT WELDING IN LARGE OR SMALL QUANTITIES.

CHAS. EISLER
EISLER ENGINEERING CO.
779-50. 13th ST. Near AVON AVE. NEWARK, 3 N. J.



# *Stymied by* THE OLDway... IMMEDIATE MASS PRODUCTION THROUGH SMITHway!

**SMITHway Electrodes in Action** — *Formerly, the Liberator Landing gear fork was made of forgings and a tube, bolted together. NOW, SMITHway Electrodes weld simple stampings into a one-piece unit, 15% stronger, 18% less raw material, adapted to speedy, economical mass production.*

"OVERNIGHT" came the demand of America's Air Forces for Liberator bombers, by the thousands! They were vital to victory . . . the "impossible" had to be done . . . equipment wasn't available . . . mass production couldn't be organized along usual lines.

Modern SMITHway Certified Electrodes and welding technique were applied . . . simple stampings, SMITHway welded, now make better landing-gear forks, *faster* . . . and mass production has again been accomplished "overnight"...the SMITHway!

The proof of the value of SMITHway Electrodes is in many of the biggest, toughest welding jobs on record. More than 320,000 of these electrodes go into successful welds daily in SMITH production.

You, too, can now use these quality-proved electrodes. Warehouse stocks in principal production areas.

Phone, wire, or write nearest office.

## Mild Steel . . . High Tensile . . . and Stainless Steel WELDING ELECTRODES

*made by welders . . . for welders*

*Have You Bought That Extra War Bond This Month?*

*SMITHway A. C. Welding Machine saves power; eliminates arc blow.*

*SMITHway Welding Monitor trains better welders faster.*

## A. O. SMITH Corporation

MILWAUKEE · WISCONSIN · HOUSTON · TEXAS

Offices also: NEW YORK, PITTSBURGH, CHICAGO, TULSA, HOUSTON, LOS ANGELES, SEATTLE

In Canada—JOHN INGLIS CO., LIMITED

electronic Weltronic bulletins

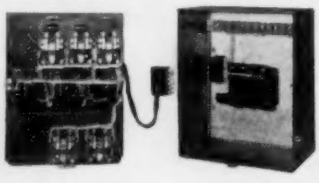
# SIMPLIFIES RE-CONVERSION OF WELDERS

Change-over from War to peace-time spot, butt and projection welding is easy with new Weltronic Universal Timers. Re-convert to new materials and gages merely by plugging-in the proper timer control panel into the universal cabinet. All Weltronic NEMA type timer control panels are interchangeable in less than one minute by means of a single plug-jack and a swing-out, lift-off mount. No extra wiring—no scrapping of parts—machine is ready for production immediately.

In addition, when operating large batteries of welders on similar jobs—keeping handy a single 'stand by' plug-in control panel assures continuous production and cuts maintenance costs.

Even higher dependability and lower maintenance is provided by exclusive Weltronic timing circuits requiring fewer, less expensive tubes.

*FOR DETAILS WRITE FOR BULLETIN NO. WTT-44*



Weltronic COMPANY

DETROIT 19, MICH.

## WINNERS IN $4750 POSTWAR PLANNING CONTEST

Awards amounting to $4750 have just been given to 15 Lincoln employees, winners in a Postwar Planning Competition, according to J. F. Lincoln, president of The Lincoln Electric Co.

Top winner of the first prize of $1000 was Jim Nicholl, foreman of the Lincoln shipping department, with the company eleven years, who submitted a paper on a deep-drawn, automatically welded steel container for export packing and shipping of electrodes. The new container would replace the present wooden box now being used. Nicholl's paper showed the general design and method of manufacturing the container, and estimated that the savings in export boxing costs and freight might run well over $25,000 per year.

One hundred sixty-one papers were submitted in the Postwar Planning Competition for the purpose, as stated in the rules, "to gather all of the ideas of each employee to assist management in planning for the future."

Second prize of $750 was won by H. E. Cable, sales engineer from the Pittsburgh office, who through an engineering study outlined a method of sales-engineering research whereby several thousand automatic welders could be sold.

Third prize winner of $600 was D. J. Burke, maintenance department employee, for his design and suggestions for building a small positioning device to hold work in various positions while it is welded.

Papers on remote control and automatic stop-start devices for use with Lincoln machines, a welded steel engine for engine-driven welders, appearance improvements, and plans for making changes in the shop organization so as to have a six-hour working day accomplish as much as an eight, were among the other prize winning papers.

## RESISTANCE WELDER IMPROVEMENTS

Tremendous improvements in the design of resistance welding machines together with excellent cooperation between manufacturers of resistance welding machines, power company officials and resistance welding machine users have solved the power load problem and eliminated the difficulties encountered ten to fifteen years ago when resistance welding equipment was connected to power lines.

This opinion was voiced by Mr. A. D. McLay, Vice-President of The Detroit Edison Co. in charge of sales, during a talk before members of the Resistance Welder Manufacturers' Association attending a meeting at the H. H. Rackham Educational Memorial Building in Detroit on Friday, September 15th.

Resistance welding machines were characterized by Mr. McLay as one of the "good tools" of modern industry. Their use, he added, definitely increases production, lowers costs and thereby places many products within the purchasing power of the average person which otherwise would be beyond their reach.

Users of resistance welding machines, in Mr. McLay's opinion, are pleased with the results they obtain and for that reason he predicted a substantial increase in their use by manufacturers during the postwar period. This new demand will come particularly from industries that have been using resistance welding equipment and know its advantages.

Fifteen or twenty years ago the installation of resistance welding machines caused power companies considerable trouble because the electric lamps of other consumers would flicker, grow dim or almost go out when the equipment was used. In addition, it caused interference with the power supply of nearby factories and was responsible for numerous complaints from other customers.

Design improvement plus better cooperation between resistance welder manufacturers, the power companies and users have enabled utilities to determine the power load required and take steps to anticipate difficulties before they actually occur. This may be done through the installation of a motor generator set, running in lines to take care of the extra load and at times isolating sections of substations to meet load requirements.

## O. C. TABBERT MADE ASSISTANT MANAGER

Harnischfeger Corp., Milwaukee, Wis., announces the recent appointment of O. C. Tabbert, formerly welding engineer in the company's Milwaukee sales district, as assistant manager of the P&H Welding Equipment Division. Mr. Tabbert's extensive welding experience includes thorough practical training in P&H's own welding shops, he later becoming a field representative in the upper Michigan and Wisconsin territories. During the past year he served a period as acting manager of the Harnischfeger District office in Jacksonville, Fla. Management of the P&H Welding Division continues under Marvin H. Rutishauser.

## WELDED PIPING FITTINGS

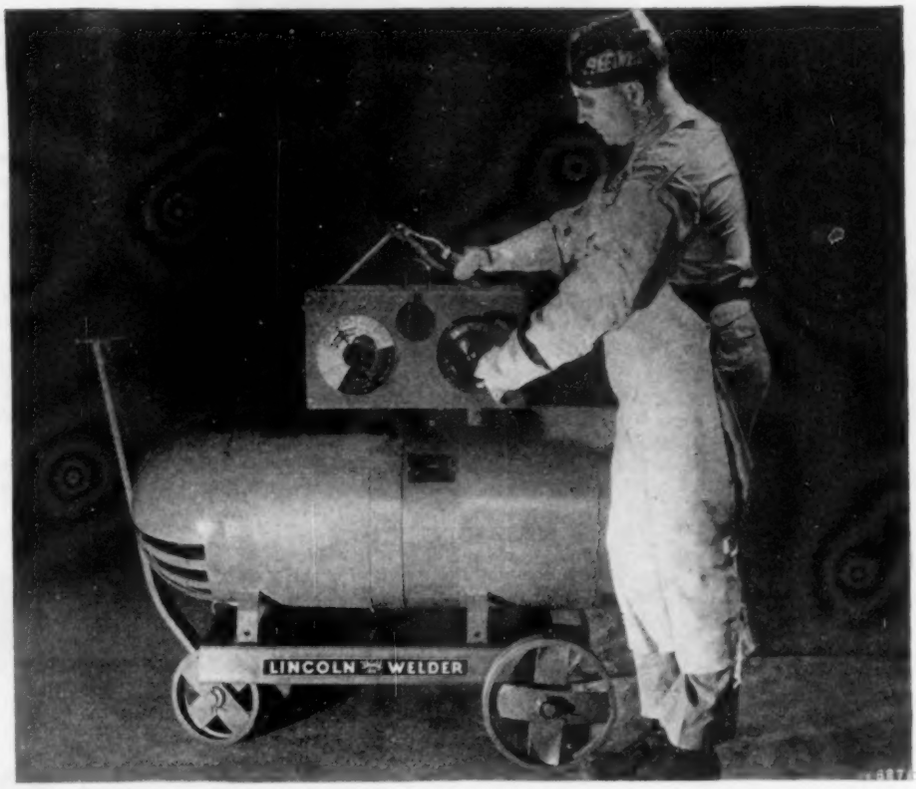
A 20-page booklet has just been issued by Tube Turns, Inc., of Louisville, Ky., giving allowable working pressures for welding fittings in five classes of piping—power, oil, district heating, gas and air, and refrigeration. Fourteen convenient tables list allowable pressures at the indicated temperatures for any size and weight Tube-Turn fittings. All tabulations are made in accordance with the Code for Pressure Piping A.S.A. B31.1-1942.

## THREE-DAY MEETING ON STRESS-CORROSION CRACKING

One of the most baffling of all metallurgical phenomena—the premature failure of metal sections caused by a combination of stress and corrosion—will receive a thorough airing at the joint symposium on stress-corrosion cracking, sponsored by American Society for Testing Materials, and the Institute of Metals Division, American Institute of Mining and Metallurgical Engineers, and scheduled for Hotel Benjamin Franklin, Philadelphia, November 29th, 30th and December 1, 1944.

# "WHY WAIT 'TIL YOU'RE CORNERED?" *he says*

***LOOK, GENERAL,*** how some are beating the gun of competition through recourse to the Lincoln "Shield-Arc" Welder:




## *Gun Beater:* THE "SHIELD-ARC" WELDER

Gives you top quality welds at highest speed because its Job Selector enables you to select the right TYPE of arc to suit the job . . .

Its Dual Continuous Control covers the widest possible range . . . for thin sheets to heaviest plates . . .

Self-protected against burnout, the "Shield-Arc" can be used to "beat the gun" with larger electrodes for sustained operation.

The full story is given in Bul. 412. Free on request.

THE LINCOLN ELECTRIC COMPANY • Cleveland 1, Ohio

## *Another* LINCOLN *Contribution to . . .*

*America's greatest natural* **recourse**

**ARC WELDING**

## OSHA PROMOTED

Wilbur C. Osha, until recently general welding superintendent at a.c.f. Berwick, Pa., plant, has been appointed general supervisor of welding for American Car and Foundry Co. In this capacity he will have supervision of welding operations at all twelve a.c.f. plants, according to Frederick A. Stevenson, President, who makes the announcement. Mr. Osha will continue to make his headquarters at Berwick, Pa.

Wilbur C. Osha

Born at Boonville, Ind., he attended the public schools of that community and later was graduated from Purdue University, class of 1932 with the degree of B.S.M.E.

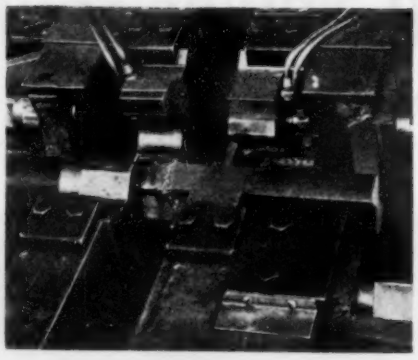
He was first employed by the Pittsburgh Testing Laboratory and in 1937 he went to the a.c.f. Berwick, Pa., plant as welding supervisor. The following year he was promoted to general welding superintendent at the Berwick plant and has continued in that capacity until his recent promotion.

He is a member of the AMERICAN WELDING SOCIETY.

## FLASH WELDING TWIST DRILL

Savings in the manufacture of twist drills have been effected by the flash welding of high-speed steel stock to a chrome nickel shank.

The photograph illustrates this process of welding an exceptionally large size drill. Note that the drill stock is welded to the shank *before twisting*—an excellent example of the strength of such a weld, in that it must be as strong as the parent metal to stand the twisting operation. After twisting, the drill is hardened and finished.



The water-cooled clamping dies for holding the stock and shank during the welding operations can be seen. These clamps act as electrodes for the transmission of current to the parts being welded, yet must be strong enough to clamp the material at twice the pressure used in the push-up operation.

Questions on the wide possibilities of resistance welding will be gladly answered by the Resistance Welder Manufacturers' Association of 505 Arch St., Philadelphia 6, Pa., through one of its members.

## PLATZ JOINS SCIAKY

Henry Thomas Platz, who for the past 20 years was associated with The Briggs Mfg. Co., as chief engineer of the tool, fixture and welding division and executive engineer of the aircraft turret division from January 1941 to June 1943, resigned to work as consulting engineer on special projects until his recent appointment as district manager of The Sciaky Bros. for the state of Ohio and eastern and northern Indiana, with offices in Cleveland, Ohio. Mr. Platz is a member of the AMERICAN WELDING SOCIETY.

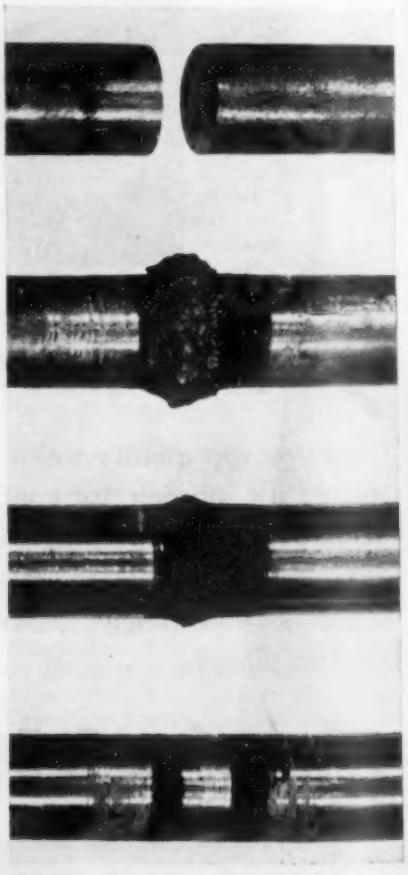
Henry Thomas Platz

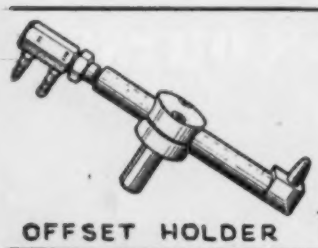
## FLASH-WELDING COLD-ROLLED STEEL ROD

In the accompanying illustration are shown four steps in the end-to-end flash welding of a cold-rolled steel rod. A similar procedure is followed in the edge-to-edge welding of metals.

The first illustration shows the two ends of the steel rod before the flash-welding operation. The second shows the flash (extrusion) resulting from the weld. In the third illustration, this flash has been removed and in the fourth the rods have been machined to the desired size. The finished weld is as strong as the parent metal itself and presents a smooth surface capable of taking any finish that might be applied to the latter.

Although applicable to areas as small as 0.0015 sq. in., flash welding particularly lends itself to the welding of large cross sections of material without prohibitive peak power demands.



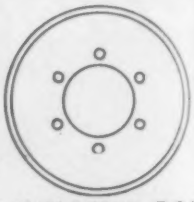
OFFSET HOLDER

"ELECTROLOY" for RESISTANCE WELDING

Butt
Flash
Spot
Seam
Projection

ELECTROLOY

Catalog and prices on request



WELDING ROLL

THE ELECTROLOY CO. INC. 1600 SEAVIEW AVE. BRIDGEPORT, CONN.

# Here's a Torch Specifically Designed for Modern Silver Brazing

No wonder skillful silver brazing operators are so enthusiastic over this new VICTOR torch.

Here are their reasons . . .

(1) The Model J27 Welding Torch has ample gas capacity, but its weight is light, its balance perfect.

(2) Adequately long flexible nozzles can be provided with single or multiple flames for light or heavy silver brazing operations.

(3) The built-in AIRADIATOR section assures a cool handle without interfering with proper flame characteristics.

(4) It is the most perfect arrangement for silver brazing of Walworth type of fittings, flanges, collars, and "L's" such as are encountered in marine work.

(5) It can be held conveniently and sturdily by both hands, far enough from the work yet kept in constant and controlled motion. The valve positioning clears the operator's hands, makes for accessibility.

(6) It produces just the right kind of feathery, soft flame—single flame for some operations, multiple flame for heavier sections. And its flexibility allows bending into the most advantageous shapes.

It is the ideal equipment for modern silver brazing operations.

**VICTOR EQUIPMENT COMPANY**

Ad 88 844 FOLSOM STREET · SAN FRANCISCO 7

High speed, low cost and reliability are inherent advantages. The flash or extrusion, resulting from the weld, when removed and polished, leaves a weld joint almost impossible to detect.

---

## THE EFFECT OF MOISTURE IN WELDING ELECTRODE COVERINGS OF THE A.W.S. E6010 TYPE

A series of tests recently completed on an E6010 type electrode should prove of interest to those who have been gathering evidence regarding the possible detrimental effects of moisture in the flux covering used on this type of heavy covered welding electrode. The moisture content of the flux covering of satisfactory electrodes was raised above the range usually considered acceptable by subjecting the electrodes to humid atmosphere and with other electrodes the moisture content was lowered by additional baking.

Samples showing moisture content at five different levels were prepared in this manner. The percentage of moisture reported represents loss in weight on drying at 280° F. for 12 hr.

A test plate was welded with each of these five samples of $^{3}/_{16}$-in. diam. E6010 electrodes, in accordance with the standard A.W.S. procedure. Two standard 0.505-in. diam. tensile specimens were machined from each plate. After completion of mechanical tests one-half of each specimen was used for chemical analysis.

The results of mechanical tests are given in Table 1 along with an idea of the appearance of half of each of the fractured test bolts.

The number of gray spots or "Fish eyes" appearing on the fractures is as follows:

| Plate No. | 2159 | 2103 | 2120 | 2114 | 2102 |
|---|---|---|---|---|---|
| A | 4 | 1 | 2 | 0 | 0 |
| B | 6 | 5 | 2 | 1 | 0 |

The results of chemical analysis are given in Table 2.

**Table 2**

| Plate No. | 2159 | 2103 | 2120 | 2114 | 2102 |
|---|---|---|---|---|---|
| % Moisture in covering | 0.51 | 2.95 | 4.61 | 8.30 | 14.54 |
| C | 0.06 | 0.05 | 0.05 | 0.06 | 0.05 |
| Mn | 0.62 | 0.57 | 0.48 | 0.51 | 0.37 |
| P | 0.014 | 0.012 | 0.011 | 0.013 | 0.015 |
| S | 0.030 | 0.026 | 0.028 | 0.029 | 0.028 |
| Si | 0.27 | 0.24 | 0.17 | 0.20 | 0.10 |

**Table 1**

| PLATE NO. | BOLT | PER CENT MOISTURE IN COATING | YIELD KIPS | TENSILE KIPS | ELONGATION % IN 2" | REDUCTION IN AREA % IN 2" |
|---|---|---|---|---|---|---|
| 2159 | A | .51 | 58.0 | 73.5 | 23.0 | 40.5 |
| 2159 | B | .51 | 59.0 | 73.7 | 23.0 | 40.5 |
| 2103 | A | 2.95 | 58.0 | 75.0 | 26.0 | 49.0 |
| 2103 | B | 2.95 | 57.5 | 74.7 | 26.0 | 46.0 |
| 2120 | A | 4.61 | 55.0 | 71.5 | 24.0 | 49.0 |
| 2120 | B | 4.61 | 55.0 | 72.2 | 25.0 | 49.0 |
| 2114 | A | 8.30 | 56.5 | 71.0 | 26.0 | 52.0 |
| 2114 | B | 8.30 | 57.0 | 73.0 | 31.0 | 57.5 |
| 2102 | A | 14.54 | 52.2 | 65.5 | 22.0 | 52.0 |
| 2102 | B | 14.54 | 53.0 | 67.5 | 24.0 | 57.5 |

Electrodes at either end of the moisture range selected were not of good welding quality. Those high in moisture content exhibited excessive blistering of the flux covering which interfered with welding. Electrodes low in moisture content were not good because of lack of arc force and also a tendency toward puffy craters and porosity of weld metal.

It seems from the results obtained in this investigation that the moisture content of the flux covering of this particular electrode may vary between wide limits without seriously affecting the yield strength, tensile strength or elongation of the deposited weld metal.

The work described in this article was performed in the laboratories of the Arcrods Corp. at Sparrows Point, Md.

**Buy "Proven Fluxes" with Years of Guaranteed Satisfaction behind them**

**The Trade-Name is "ANTI-BORAX"**

***Ask for Them*** ***Unequalled for Quality***

**A Flux for every metal: Cast Iron Welding Flux No. 1; Brazing Flux No. 2; Braz-Cast Flux No. 4, for bronze-welding cast iron; "ABC" Aluminum Flux No. 8 for sheet Aluminum and all alloys of Aluminum; Stainless Steel Flux No. 9; Silver Solder Brazing Flux No. 10; No. 16 Silver Solder Paste Flux.**

**ANTI-BORAX COMPOUND COMPANY**
**Fort Wayne, Indiana**

**WANTED: SALES MANAGER**

A real opportunity for a man with the proper qualifications to head up our sales activities. Our company, located in a large city in the middle west, manufactures and sells welding equipment, rods and flux, and is one of the leaders in the industry. These products enjoy national distribution to manufacturers through distributors as well as salaried sales engineers. Welding experience and engineering training desirable but not essential if applicant can prove that he can be successful without this background. Compensation more than $5,000 per year with opportunity to share in profits. Write fully giving education, experience and personal facts that are pertinent. Also send photograph. Box V-150.

# A "Tip" on Tips

If you're having trouble finding the right spot welding tip to do a tough job, Mallory may have the answer.

The Mallory line includes among its large variety of resistance welding electrodes, spot welding tips of shapes and sizes to suit practically every application.

They're made of Elkaloy* A, Mallory 3† metal and other Mallory alloys—designed to weld mild carbon and alloy steels, plated metals and non-ferrous metals, including aluminum and magnesium.

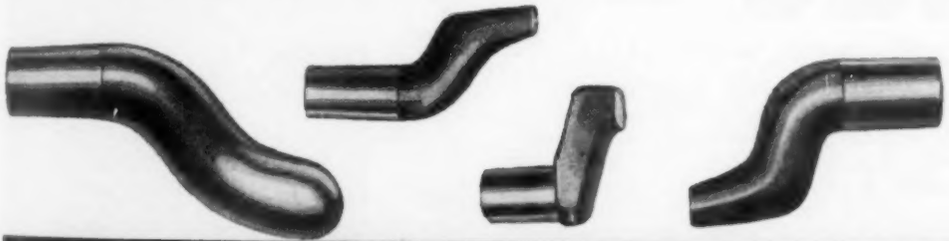
Standard tips of Mallory alloys, with their high resistance to annealing at elevated temperatures, avoid excessive "mushrooming" . . . cut costly "down time" for tip dressing.

Mallory standard water-cooled tip holders dissipate heat, maintain maximum electrode efficiency and speed up production. They are available in straight, offset and universal types for regular or heavy duty applications. Handy ejection devices allow a quick change of tips.

Write today for a copy of the Mallory Resistance Welding Electrode Catalog.

*Registered trademark of P. R. Mallory & Co., Inc., for welding electrode material*
*†Registered trademark of P. R. Mallory & Co., Inc., for copper alloys*

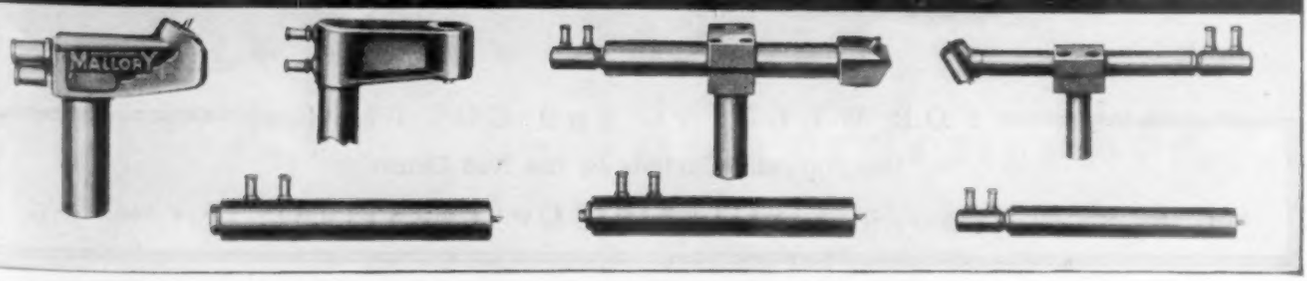
**P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA**



*Reminder — Buy Another War Bond Today*

P R MALLORY & CO Inc

**MALLORY** *Standardized Resistance Welding Electrodes*

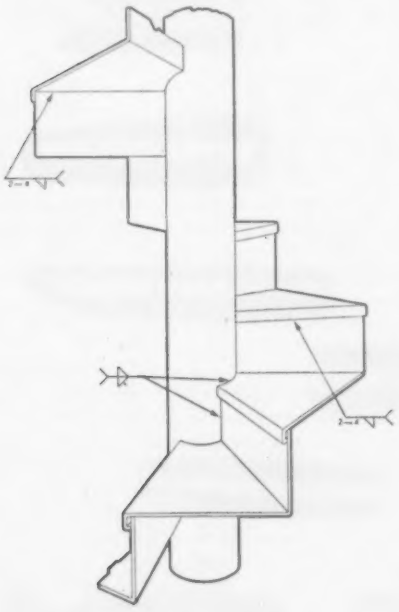


## SPIRAL STAIRS WELDED TO PIPE

Only a fraction of the space normally required is used in these arc-welded circular stairways that are being fabricated and erected in many war plants where space is at a premium.

This convenient passageway from floor to floor can be installed in only a 6 ft. 6 in. space by cutting a hole in the ceiling, anchoring a 6-in. pipe in the center and welding the one-piece steps and riser to the pipe. The steps and risers are formed from a single pattern of 1/8-in. plate, welded to the pipe, and each riser is welded to the next step above.

For safety and additional reinforcing, a 16-gage band is welded to the outside of the steps and scrap pieces of iron pipe are welded to uprights for hand rail.



Spiral Stairs on Pipe (without Side Guard or Hand Rail)

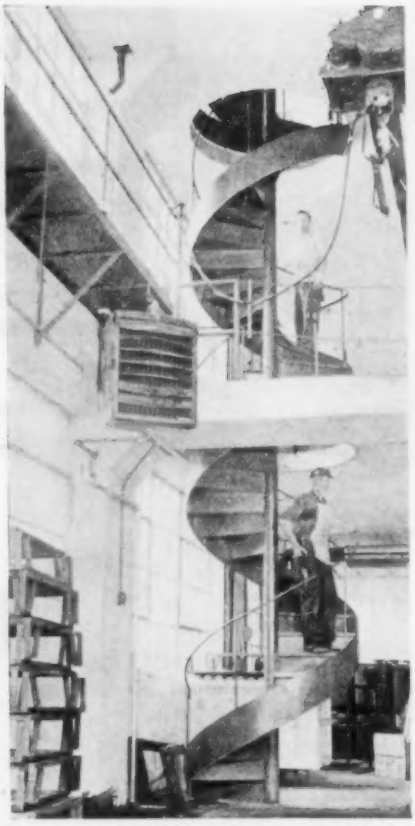


*Photo courtesy The Hobart Brothers Co., Troy, Ohio*

## TOOL STEEL WELDING MANUAL

The technical information contained in the new 40-page tool steel welding manual and catalog, just published by Welding Equipment & Supply Co., 223 Leib Street, Detroit 7, Michigan comprises complete data on metallic arc tool steel welding, which is the accumulation of eight years of extensive research, development and practical experience in the tool steel welding field.

Methods outlined include:

1. How existing die units can be kept in operation with a minimum of "down-time."
2. How changes can be made during die "try-out" periods by correcting design, rectifying errors, etc.
3. How contours, corners and edges of old dies can be welded during die "change-over" to adapt them to change of design.
4. How die units can be compositely fabricated by welding with desired tool steel electrodes on mild or medium carbon steel to form cutting edges or working areas.

In addition, exact procedures and welding sequences are outlined. Copy available on request.


National

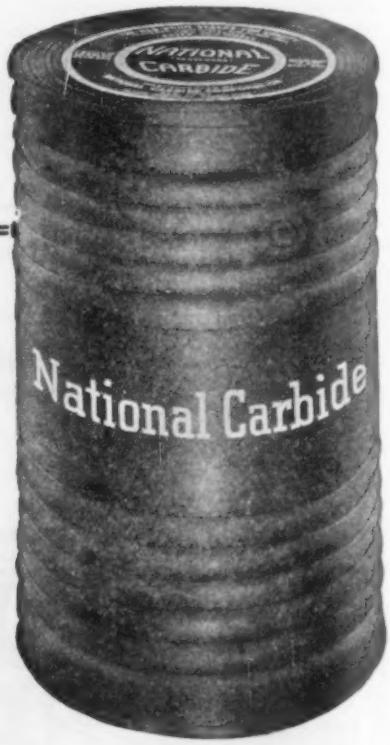
Carbide

IN THE RED DRUM

EFFICIENT

ECONOMICAL

DEPENDABLE




FOR WELDING and CUTTING

Use National Carbide in the Red Drum

60 E. 42nd St. NATIONAL CARBIDE CORPORATION New York, N. Y.

## A NEW 16MM. SOUND FILM

### *Here It Is! The Dramatic Story of Production Welding—Brought to You Via Motion Pictures*

"New Horizons in Welding" is the first complete story of production welding ever to reach the screen . . . 30 fast-moving minutes of *sound* screen entertainment.

Here is the drama of the electric arc — the gleam that has grown from a glimmer — *grown 500 times in 10 years!* Here, too, is an education in the methods used to cut costs and speed production where welding has hit the peak of its development — in the fabrication of all-welded products.

### An "Inside" Story — But Available to All

"New Horizons in Welding" is *really* an inside story . . . filmed in the plant of one of the world's largest *makers* as well as *users* of all-welded equipment. There you see the step-by-step procedure for welding on a mass production basis. *Every step,* from the birth of a project in the blueprint department to the host of labor-saving devices which speed it to completion — you'll see them all in "New Horizons in Welding."

P&H offers this absorbing, educational feature *without cost* to all interested groups — manufacturers, industrial schools, shipyards, government agencies, etc. Inquiries should be addressed to: Harnischfeger Corporation, Welding Division, 4551 West National Avenue, Milwaukee 14, Wisconsin.

P&H

Overhead Cranes • Electric Hoists
Excavators • Welding Positioners
Arc Welders • Welding Electrodes

HARNISCHFEGER
CORPORATION
WELDING ELECTRODES • MOTORS • HOISTS P&H ELECTRIC CRANES • ARC WELDERS • EXCAVATORS

*Canadian Distribution:* The Canadian Fairbanks-Morse Company, Ltd.

# NEW PRODUCTS

**The Society assumes no responsibility for the validity of claims in this Section**

## FLUX FOR TINNING CAST IRON

The Air Reduction Research Laboratories have developed a flux designed to promote uniformly successful tinning of cast iron prior to brazing. The manufacturer states that this flux, known as Airco Hi-Bond, overcomes the difficulties encountered in tinning cast iron due to its graphitic nature and makes possible highly satisfactory tinning of cast iron especially of high carbon and silicon content or low combined carbon analysis.

The flux *does not* take the place of the regular flux used for the actual brazing operation. Hi-Bond Flux may be applied as a water-mixed paste or as a powder sprinkled on the surface which has already been heated to the required temperature. It is packed in 1-lb. glass containers and is available from Airco offices and distributors throughout the country.

Additional details may be obtained by writing to the manufacturer, Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.

## HIGH-SPEED STEEL ELECTRODE

The American Manganese Steel Division of American Brake Shoe Co., Chicago Heights, Ill., manufacturers of Conservation Welding Materials," has announced a new welding rod known as Amsco Tool-Face.

This new high-carbon, high-chromium, molybdenum, tungsten and vanadium bearing welding rod is commonly known as high-speed steel. Its present uses are manufacturing composite cutting tools such as for lathes, shapers, etc. It is also used in manufacturing composite forging dies, rock drill bits, and for salvaging high-speed tool steel parts that become broken or worn by impact and abrasion. It has a guaranteed Brinell hardness of between 575 and 675.

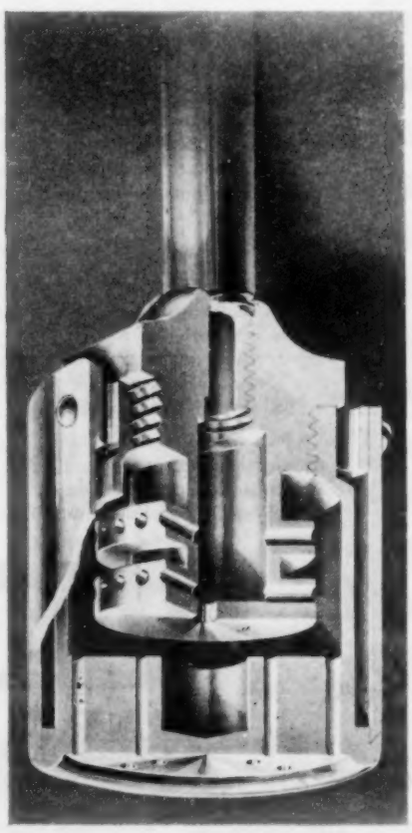
It can also be used as a general hard-surfacing rod where extreme hardness and resistance to shock are of primary importance. It is available in standard lengths and for gas or arc welding.

## MULTI-FLAME HEATING NOZZLES

A new heating nozzle, designed particularly for use with oxygen and the liquefied petroleum gases or natural gas, is now offered by Victor Equipment Co., 844 Folsom St., San Francisco 7, Calif. This heating nozzle fits all Standard Victor welding torch butts but can also be sold complete.

The design features of this particular nozzle incorporate an outer air mantle to protect the nozzle head against deflected heat. Its internal design is such that the cool and premixed gases carry away a substantial amount of accumulated heat, and in doing so become efficiently preheated for proper combustion. Similar multi-flame heating nozzles are also available in numerous sizes for use with oxyacetylene.

The larger multi-flame heating nozzles are recommended for flame priming and descaling in inaccessible areas. All of them can be employed for various silver brazing operations, preheating and bending. Multi-flame nozzles are a most useful adjunct to all good welding torches.



## TIPPING TOOLS

Carbide and high-speed steel tipped tools are generally tipped by preplacing a strip of brazing alloy, together with a sufficient amount of flux, between the tip and the shank. The assembly is then placed in a furnace, or heated with an induction coil. This procedure, however, is sometimes objectionable, as the foil may become tarnished or oxidized and then require a temperature considerably above its own melting point to flow freely. Experiments have proved that the use of alloys in powder form would present definite advantages over the use of silver brazing alloys in the form of foil.

There are, therefore, two outstanding silver-copper and one copper alloy used for tipping tungsten carbide and high-speed steel tools now available in a fine powder. These alloys are very economical in use since the required flux is mixed right in with the powdered alloy. This eliminates any waste of flux during preparation. Then, too, the powder does not require the special handling necessary for cutting the foil into small pieces for exact preplacing.

These alloys are the product of the Eutectic Welding Alloys Co. They are known as:

EutecRod 1800 (lowest melting) for H.S.S. 950–1140° F.
EutecRod 1601 (high tensile) for tungsten carbide 1020–1250° F
EutecRod 16 (heat resistant, high tensile), for tungsten carbide 1300–1750° F. (furnace temp.).

After the customary degreasing and grinding, the powdered alloy is spread on the surfaces to be joined, and the tungsten carbide tip is placed on top. The assembly is then heated until the alloy melts.

# Your Never-Failing Source of Quality Electrodes for Every Type of Weld

The reasons for the superior performance of Reid-Avery Electrodes can be stated simply and briefly: Twenty-five years' experience, the best and most modern equipment plus skilled craftsmanship constantly guided by advanced laboratory procedure. • It is under such favorable conditions that each of the following complete list of Reid-Avery Electrodes is produced.

| ELECTRODE | A.W.S. CLASSIFICATION | MATERIAL TO BE WELDED | TYPE OF WORK | CURRENT |
|---|---|---|---|---|
| RACO 7 | E-6010 | Mild Steel | All Position | Rev. Pol. |
| RACO 11 | E-6011 | Mild Steel | All Position | A.C. |
| RACO 8 | E-6012 | Mild Steel | General Purpose<br>Poor Fit-up | Str. Pol.<br>or A.C. |
| RACO 8 | E-6013 | Mild Steel | General Purpose<br>Light Gauge | Str. Pol.<br>or A.C. |
| RACO 6 | E-6020<br>E-6030 | Mild Steel | Butts, Positioned<br>Fillets and Deep Grooves | A.C. or<br>D.C. |
| RACO 20 | E-6020<br>E-6030 | Mild Steel | Single Pass -<br>Fillets or Grooves | A.C. or<br>D.C. |
| RACO 5 | E-6030 | Mild Steel | Deep Grooves | A.C. or<br>D.C. |
| RACO 82 | None | Steel | All Position<br>Wear-resisting Machinable | Str. Pol.<br>or A.C. |
| RACO 74 | E-7010 | High Strength Steels | All Position | Rev. Pol. |
| RACO 64 | E-7020<br>E-7030 | High Strength and<br>Silicon-killed Steels | Butts, Positioned<br>Fillets and Deep Grooves | A.C. or<br>D.C. |
| RACO 13 | E-6013 | Mild Steel | General Purpose<br>Poor Fit-up | A.C. or<br>D.C. |
| TYPE D | E-4511<br>E-4521 | Mild Steel | Automatic or<br>Manual | Str. Pol. |
| TYPE D<br>30-40 C | None | Steel | Automatic or Manual,<br>Wear-resisting Machinable | Str. Pol. |
| TYPE M | E-4511<br>E-4521 | Mild Steel | Automatic or<br>Manual | Str. Pol. |
| BLUE LABEL | E-4510<br>E-4520 | Mild Steel | Manual | Str. Pol. |
| RACOLLOY 19-9 | None | Stainless and Air-Hardening Steels | Welding and Surfacing | Rev. Pol. or A.C. |
| RACOLLOY 25-20 | None | Stainless and Air-Hardening Steels | Welding and Surfacing | Rev. Pol. or A.C. |

The

## REID-AVERY COMPANY

DUNDALK BALTIMORE 22 MARYLAND

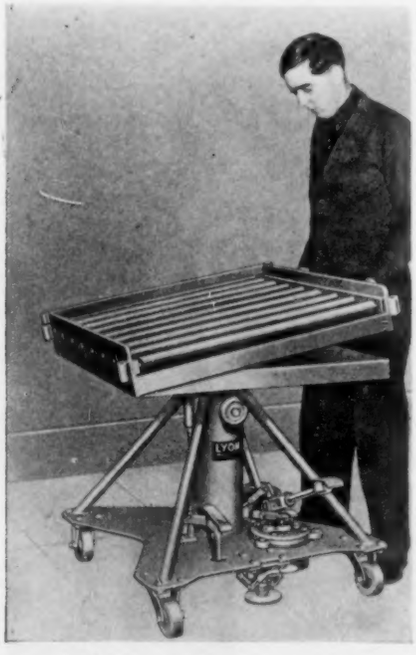
SINCE 1919 • PRODUCERS OF ARC WELDING ELECTRODES AND WELDING RODS

The metal flows freely at a very slight increase in temperature above the melting point since the weld metal is pulverized. Oxidation of the tungsten carbide is prevented, as each particle of molten alloy immediately "tins" and adheres to the surfaces being joined.

---

## HYDRAULIC ELEVATING TABLES

The Lyon-Raymond Corp., 1815 Madison St., Greene, N. Y., now offers a desirable new optional feature for their Hydraulic Elevating Table—a *removable and reversible roller top*. This brings to eight the number of extras available to increase the versatility of the elevating table. The roller top may be supplied when a table is ordered or it can be obtained for a table already in use.



Instant installation or removal of the roller top is possible since the framework fits down over the permanent top, eliminating any necessity for volts or other fastenings. The roller top consists of a rigid, welded framework, supporting ball bearing conveying rolls.

Since the table top is square, the roller top can be placed to convey from front to back, or from side to side. This understandably increases the table's usefulness for a great many applications.

With the roller top, the hydraulic elevating table is commonly used in conveyor systems to accomplish a change in level or direction. It is also highly desirable in many die-handling and feeding operations.

---

## BATTERIES POWER VERSATILE "POSTWAR" WELDERS

Two spectacular "Postwar" additions to the new storage-battery powered line of resistance welders recently announced by Progressive Welder Co., 3050 E. Outer Drive, Detroit 12, Mich., were shown for the first time at the National Metal Congress Exposition in Cleveland, October 16th to 20th.

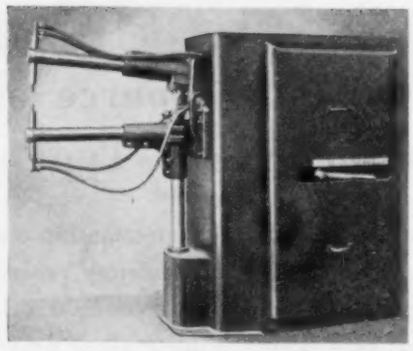


Fig. 1—New Progressive Welder "Economy" Type Spot Welder Powered with Storage Batteries

The first of the new additions is an "economy" spot welder of the rocker arm type, completely self-contained, with storage batteries, contactor-controller and infinitely variable heat-control regulator all enclosed in the base of this compact machine.

The second machine is of the heavy-duty type and designed so that both spot and roll welding can be performed on the same machine with but minor changes. Batteries for this type of machine are housed—with contactors, battery chargers and controllers—in standardized "power-pack" units.

In addition to ability to weld conventional steels with these welders, both models are designed to handle spot welding of such important "postwar" materials as stainless steel, aluminum, etc. The heavy-duty welder, for instance, will spot weld structural aluminum up to two-sections of $^{3}/_{16}$-in. thickness.

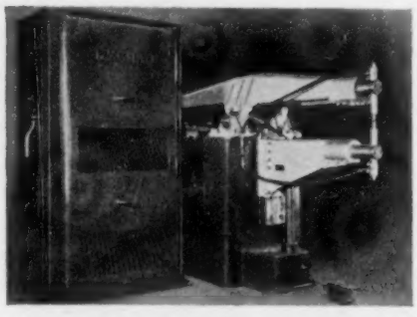


Fig. 2—New Heavy-Duty Progressive Spot Welder with Storage Battery Power Pack, Contactor and Controller Cabinet

Both machines were shown in operation in Cleveland, and although tremendous amounts of currents were required for some of the heavy-duty welding operations, only a portable type of connection to the auditorium's power supply was required to keep the batteries fully charged.

Particularly important with this type of welding equipment, Progressive engineers pointed out, is that due to its simplicity relatively unskilled help can be used not only to operate but also to service and maintain the machines. When welding such materials as aluminum for instance, they pointed out, only simple non-synchronous type timers are required.

## WELDED HEAT TREAT OVEN

This small oven was designed by James Neary, a welder at Tycoon Tackle Co. of Florida for preheating inner and outer cylinders of certain airplane parts to a temperature of 800 to 900° before welding.

It eliminates the use of the large ovens in the heat-treating department as it is operated right in the welding department where it heats the parts quickly and evenly so that the production welder does not have to wait for the heated parts. The preheating eliminates the possibility of cracks in the weld.

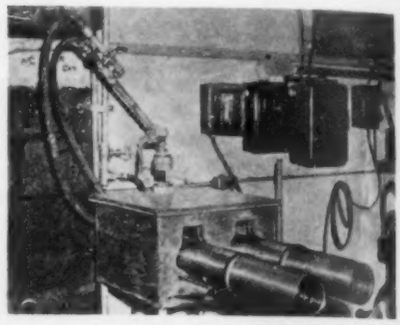


*Photo courtesy The Hobart Brothers Co., Troy, Ohio*

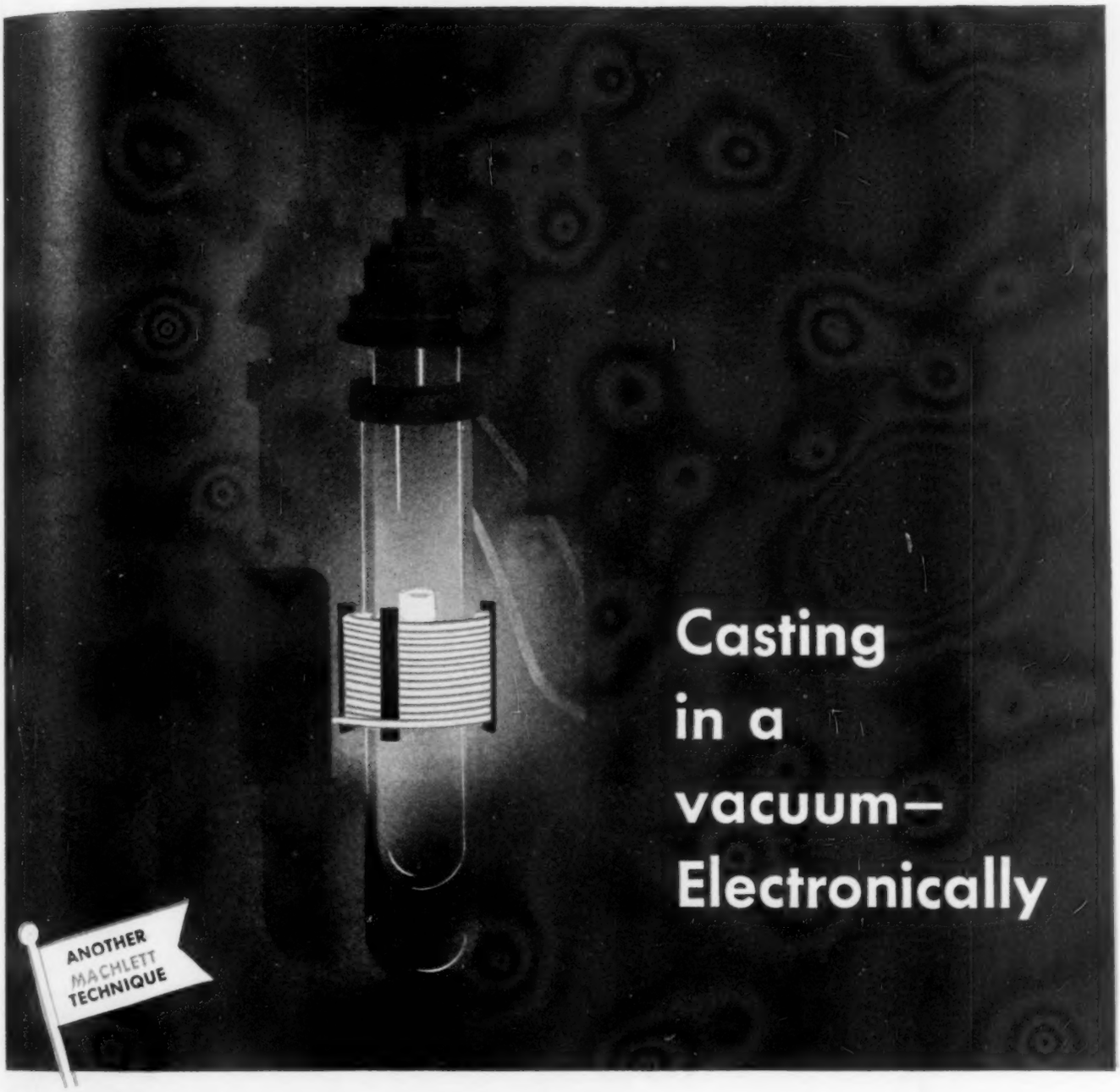
Fabricated by welding of quarter-inch steel, the oven is comprised of a double wall lined with 1-in. asbestos sheeting all the way around. The box has a removable lid on which a fixture is welded so that an air pressure gas cap shoots a flame into the oven, hitting a square of fire brick. Oven, 24 x 24 x 18 in., is mounted on 1-in. pipe legs and is heated by city gas. It has proved invaluable for quick preheating, blueing two cylinders in ten minutes.

In this case four different parts are welded to form the one aircraft assembly. The material that is preheated and welded is chromally steel.

---

## HEATING TORCH

A new medium-weight heating torch has been announced by the Air Reduction Sales Co. This new torch (Style 9802) is especially designed for concentrated localized heating such as is required for bending, straightening and shrinking of steel plate as well as for silver brazing of heavy copper plate in the manufacture of copper

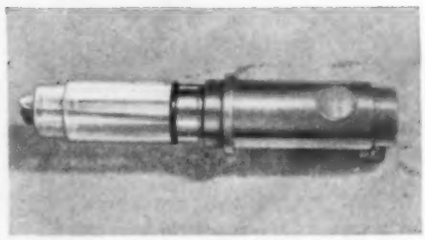



# Casting in a vacuum—Electronically

One of the many vital processes that give Machlett vacuum tubes their remarkable quality is a novel method of casting electrodes in a vacuum. Anodes for X-ray tubes, and complex parts of high-frequency oscillators are made by this unusual technique. Purified copper rod is placed over a mould in a graphite crucible, and the whole enclosed within a double-walled water-cooled quartz-silicon tube, which is encircled by a high-frequency coil. A vacuum of about $10^{-5}$ mm. of mercury is maintained.

When the current is turned on, the metal melts and flows into the mould. Cooling is precisely controlled by adjusting the position of the heating coil, so that crystals form longitudinally, for maximum heat transfer under operating conditions.

This method accomplishes a number of things, quickly and simply. No gases can be occluded in the metal to shorten tube life by reducing the vacuum. Oxides cannot form. There are no "pipes" in a casting thus poured. Dimensions can be held to about 1/10,000th of an inch—and accurate dimensions are as important as metal purity in protecting tube performance, both assuring the maximum designed performance and long life. Techniques such as this make possible the production of the tube shown above . . . Machlett Laboratories, Inc., Springdale, Connecticut.



*EG-50—an X-ray tube with beryllium window for radiography of light materials and thin sections.*

MACHLETT

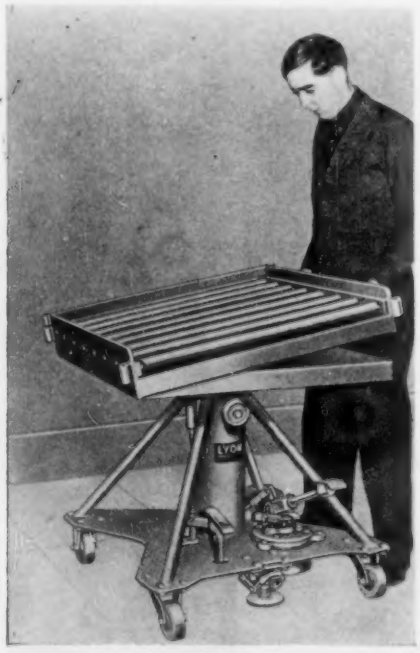
X-RAY TUBES SINCE 1898

TODAY THEIR LARGEST MAKER

The metal flows freely at a very slight increase in temperature above the melting point since the weld metal is pulverized. Oxidation of the tungsten carbide is prevented, as each particle of molten alloy immediately "tins" and adheres to the surfaces being joined.

## HYDRAULIC ELEVATING TABLES

The Lyon-Raymond Corp., 1815 Madison St., Greene, N. Y., now offers a desirable new optional feature for their Hydraulic Elevating Table—a *removable and reversible roller top*. This brings to eight the number of extras available to increase the versatility of the elevating table. The roller top may be supplied when a table is ordered or it can be obtained for a table already in use.



Instant installation or removal of the roller top is possible since the framework fits down over the permanent top, eliminating any necessity for volts or other fastenings. The roller top consists of a rigid, welded framework, supporting ball bearing conveying rolls.

Since the table top is square, the roller top can be placed to convey from front to back, or from side to side. This understandably increases the table's usefulness for a great many applications.

With the roller top, the hydraulic elevating table is commonly used in conveyor systems to accomplish a change in level or direction. It is also highly desirable in many die-handling and feeding operations.

## BATTERIES POWER VERSATILE "POSTWAR" WELDERS

Two spectacular "Postwar" additions to the new storage-battery powered line of resistance welders recently announced by Progressive Welder Co., 3050 E. Outer Drive, Detroit 12, Mich., were shown for the first time at the National Metal Congress Exposition in Cleveland, October 16th to 20th.

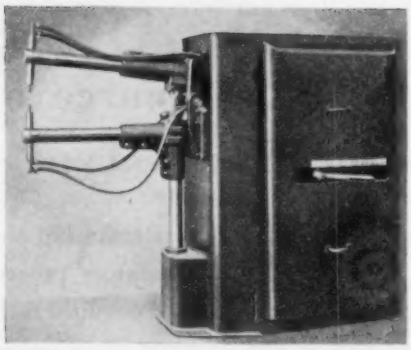


Fig. 1—New Progressive Welder "Economy" Type Spot Welder Powered with Storage Batteries

The first of the new additions is an "economy" spot welder of the rocker arm type, completely self-contained, with storage batteries, contactor-controller and infinitely variable heat-control regulator all enclosed in the base of this compact machine.

The second machine is of the heavy-duty type and designed so that both spot and roll welding can be performed on the same machine with but minor changes. Batteries for this type of machine are housed—with contactors, battery chargers and controllers—in standardized "power-pack" units.

In addition to ability to weld conventional steels with these welders, both models are designed to handle spot welding of such important "postwar" materials as stainless steel, aluminum, etc. The heavy-duty welder, for instance, will spot weld structural aluminum up to two-sections of $^{3}/_{16}$-in. thickness.

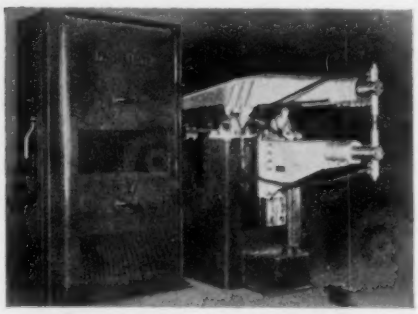


Fig. 2—New Heavy-Duty Progressive Spot Welder with Storage Battery Power Pack, Contactor and Controller Cabinet

Both machines were shown in operation in Cleveland, and although tremendous amounts of currents were required for some of the heavy-duty welding operations, only a portable type of connection to the auditorium's power supply was required to keep the batteries fully charged.

Particularly important with this type of welding equipment, Progressive engineers pointed out, is that due to its simplicity relatively unskilled help can be used not only to operate but also to service and maintain the machines. When welding such materials as aluminum for instance, they pointed out, only simple non-synchronous type timers are required.

## WELDED HEAT TREAT OVEN

This small oven was designed by James Neary, a welder at Tycoon Tackle Co. of Florida for preheating inner and outer cylinders of certain airplane parts to a temperature of 800 to 900° before welding.

It eliminates the use of the large ovens in the heat-treating department as it is operated right in the welding department where it heats the parts quickly and evenly so that the production welder does not have to wait for the heated parts. The preheating eliminates the possibility of cracks in the weld.

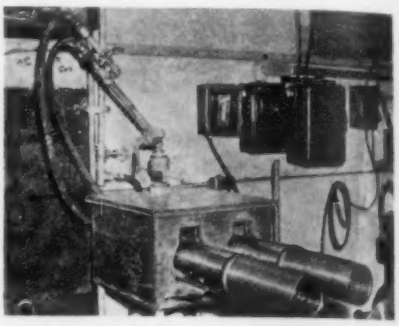


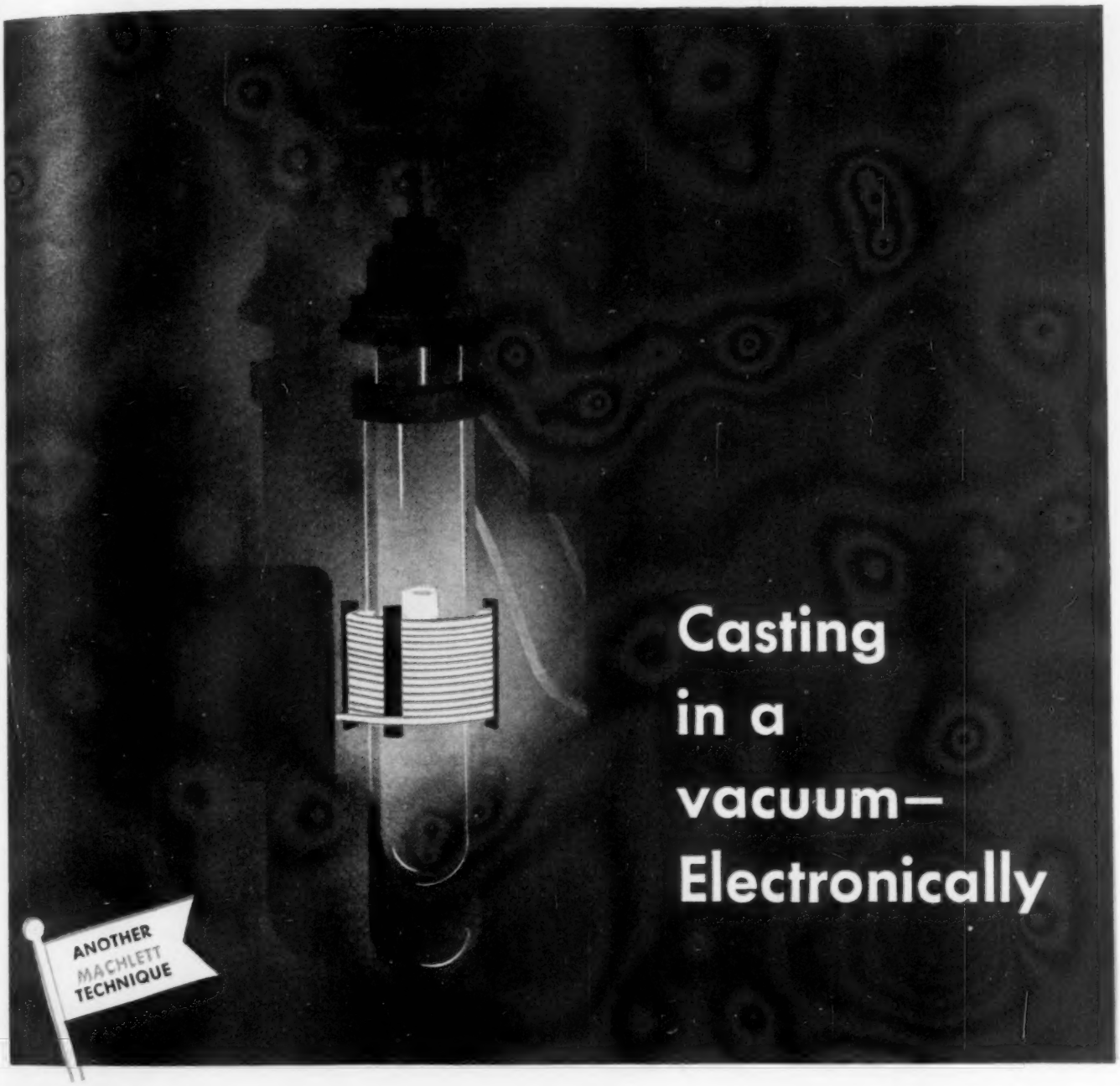
*Photo courtesy The Hobart Brothers Co., Troy, Ohio*

Fabricated by welding of quarter-inch steel, the oven is comprised of a double wall lined with 1-in. asbestos sheeting all the way around. The box has a removable lid on which a fixture is welded so that an air pressure gas cap shoots a flame into the oven, hitting a square of fire brick. Oven, 24 x 24 x 18 in., is mounted on 1-in. pipe legs and is heated by city gas. It has proved invaluable for quick preheating, blueing two cylinders in ten minutes.

In this case four different parts are welded to form the one aircraft assembly. The material that is preheated and welded is chromally steel.

## HEATING TORCH

A new medium-weight heating torch has been announced by the Air Reduction Sales Co. This new torch (Style 9802) is especially designed for concentrated localized heating such as is required for bending, straightening and shrinking of steel plate as well as for silver brazing of heavy copper plate in the manufacture of copper

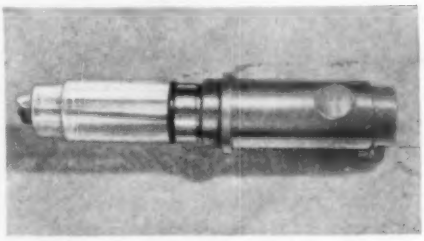



# Casting in a vacuum—Electronically

One of the many vital processes that give Machlett vacuum tubes their remarkable quality is a novel method of casting electrodes in a vacuum. Anodes for X-ray tubes, and complex parts of high-frequency oscillators are made by this unusual technique. Purified copper rod is placed over a mould in a graphite crucible, and the whole enclosed within a double-walled water-cooled quartz-silicon tube, which is encircled by a high-frequency coil. A vacuum of about $10^{-5}$ mm. of mercury is maintained.

When the current is turned on, the metal melts and flows into the mould. Cooling is precisely controlled by adjusting the position of the heating coil, so that crystals form longitudinally, for maximum heat transfer under operating conditions.

This method accomplishes a number of things, quickly and simply. No gases can be occluded in the metal to shorten tube life by reducing the vacuum. Oxides cannot form. There are no "pipes" in a casting thus poured. Dimensions can be held to about 1/10,000th of an inch—and accurate dimensions are as important as metal purity in protecting tube performance, both assuring the maximum designed performance and long life. Techniques such as this make possible the production of the tube shown above . . . Machlett Laboratories, Inc., Springdale, Connecticut.



*EG-50—an X-ray tube with beryllium window for radiography of light materials and thin sections.*

MACHLETT

X-RAY TUBES SINCE 1898

TODAY THEIR LARGEST MAKER

pipe. The torch is lighter in weight than heating torches that have been available in the past, yet it has equal gas capacity.

Five new multi-flame acetylene heating tips as well as two multi-flame propane heating tips are available for this torch. These seven tips will meet the requirements of every heavy heating job.

Three mixers are available for the torch, viz., for positive pressure acetylene, low pressure acetylene and for propane. The available extensions include a 12-in straight extension and 18-, 24- and 42-in. angular extensions.

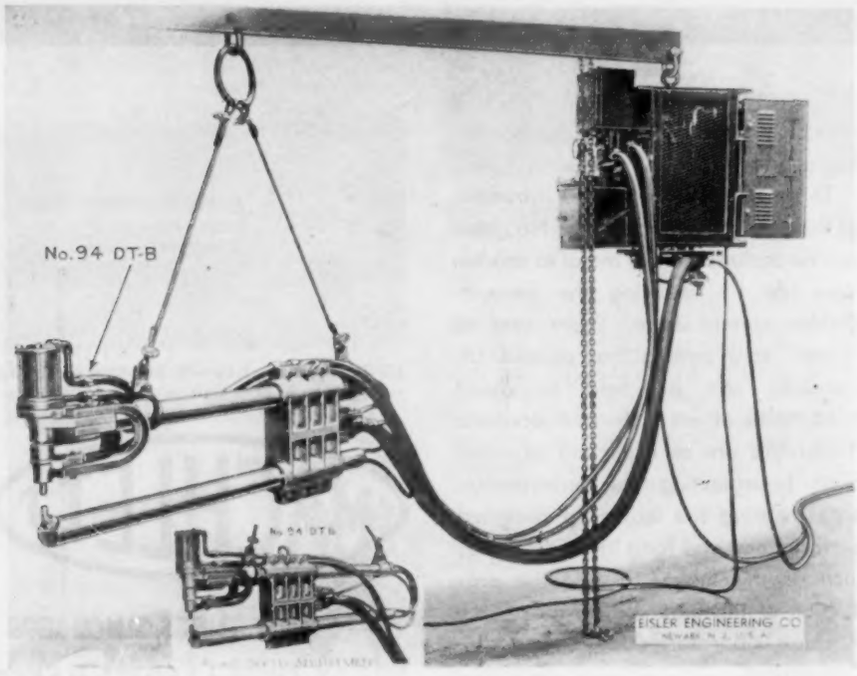
For further information, write to the manufacturer, Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.

## PORTABLE AIR-OPERATED GUN WELDER

Emphasizing the economical usefulness of extending the field of service of portable resistance welding equipment, considerable work has been accomplished by the Eisler Engineering Co. Newark, 3 N. J., in improving and simplifying the adaptability of portable welders to a wide variety of postwar uses.

The Eisler model of a portable gun welder is shown in the accompanying photo. It is a direct air-operated welding machine, equipped with a double-acting air cylinder and the necessary operating mechanism, fully or semiautomatic, depending on the choice of control. The power part consists of an air-cooled transformer, with an 8 tap switch for heat regulation (7 on and 1 off position), a pneumatic or electronic actuated timer and a high-speed mechanical or electronic contactor for accurately timing the weld in speed or automatic repeat of strokes. The weld cycle can be initiated by a foot switch as illustrated, or push button. The air system includes solenoid operated air valves, air filter, pressure regulator, gage and switch and an air line oiler. The kickless cables of 500 M.C.M. are sufficiently water cooled in a single circuit.

A distinctive feature of this Eisler model portable gun welder is the convenient adjustment to different throat depths in as range of 12 to 48 in. as shown in insert.




## X-RAY MACHINE

An entirely new X-ray instrument, the Geiger-Counter Spectrometer, was unveiled publicly at the National Metal Congress and Exposition October 16th to 20th in Cleveland.

The new Geiger-Counter X-ray Spectrometer utilizes a Geiger-Muller tube to measure the intensity and position of interference lines which are encountered in X-ray diffraction analysis work. Where film-type equipment is used, quantitative intensity measurement is more difficult—thus, the new spectrometer fills a definite need where such quantities must be measured with extreme accuracy.

For further information address North American Philips Co., Inc., 100 East 42nd St., New York 17, N. Y.

## ELECTRONIC TIMER

The application of an Electrical Industries electronic timing control to a.-c. resistance welding operations steps up product quality and uniformity; assures rapid, consistent welds, even with an inexperienced operator. Easily applied to either existing or new installations, a single knob gives instant time control from 1 to 28 cycles in steps of one cycle. Welding current is electronically switched, with absolute freedom from contactor uncertainties, maintenance, arcing and pitting—thus perfect timing is assured. This compact, easy to install device handles welding

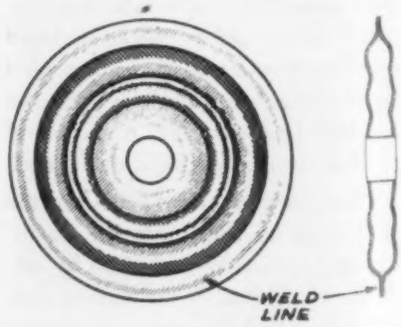
powers of from 1/2 to 5 kva. Quality workmanship, rugged industrial design and skillful engineering are featured for maximum service life. For further information write to Electrical Industries, Inc., 42 Summer Ave., Newark 4, N. J.

## PRESSURE GAGE DIAPHRAGMS WELDED

Diaphragms for sensitive pressure gages are now produced by seam welding instead of the old method of crimping and soldering the edges.

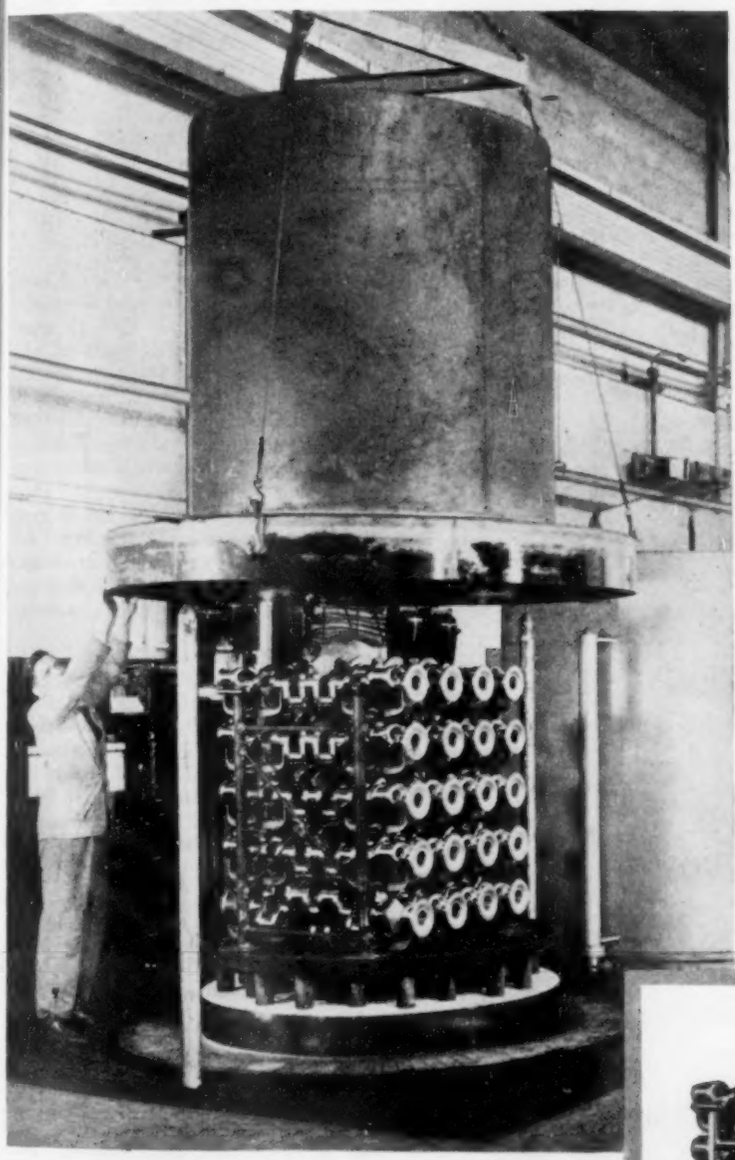
Formerly made of beryllium-copper, or phosphor-bronze, these diaphragms are now manufactured of stainless steel and Monel, ranging from 0.006 to 0.008 in. in thickness.

As in many cases where resistance welding has been introduced, a reduction in manufacturing operations was effected. Where before, two separate stampings had to be made allowing an extra flange on one stamping for crimping, now two sections of the same stamping are seam welded to-



*Packard reports:*

# EXCELLENT RESULTS from WELDED INCONEL HOODS and RACKS in nitriding of Rolls-Royce crankshafts



Late in '41, Packard installed modern equipment for nitriding Rolls-Royce aircraft engine crankshafts.

The hoods are made of Inconel sheet ... welded *gas-tight* to confine the dissociated ammonia used in the nitriding process. The carrying racks are welded from Inconel tubing and bar.

Examined recently ... after almost 2½ years of severe service at the nitriding temperatures of 900° to 1100° F.... neither the hoods, the racks, nor any of the welds show sign of deterioration.

Inconel ... a strong and ductile high nickel-chromium alloy for corrosive high temperature service ... welds readily, forms equipment that *lasts*. It does not absorb nitrogen and thus is free from embrittlement.

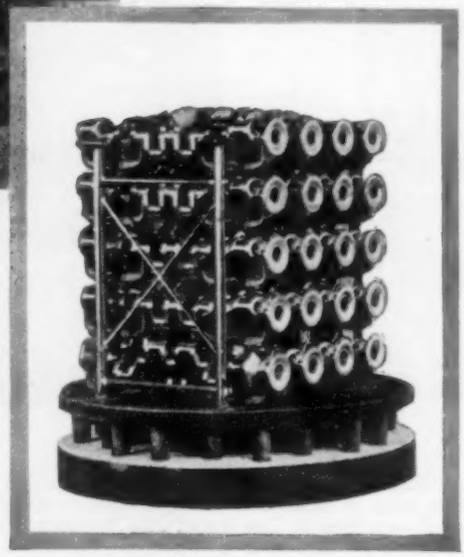
For further information about the welding of Inconel and other INCO Nickel Alloys, address:

**THE INTERNATIONAL NICKEL COMPANY, INC.**
**67 Wall Street** **New York 5, N. Y.**

**NICKEL INCO ALLOYS**

**MONEL • "K" MONEL • "S" MONEL • "R" MONEL**
**"KR" MONEL • INCONEL • "Z" NICKEL • NICKEL**
*Sheet ... Strip ... Rod ... Tubing ... Wire ... Castings ... Welding Rods*

NITRIDING CRANKSHAFTS FOR ROLLS-ROYCE AIRCRAFT ENGINES. *The Inconel hoods and carrying racks are exposed to dissociated ammonia at 900° F.... give no evidence of deterioration from oxidation or scaling, or embrittlement. The welds are as sound as the parent metal.*



INCONEL RACK *loaded with crankshafts for nitriding treatment. Inconel equipment is readily welded from mill forms ... is especially recommended where equipment must maintain strength and resistance to oxidation at high temperatures.*

gether. This has produced a better diaphragm at less cost than was heretofore possible.

This problem, presented to the Resistance Welder Manufacturers' Association of 505 Arch St., Philadelphia 6, Pa., is only one of the many solved by its members to speed up the war effort, as well as to open new horizons for postwar fabrication problems.

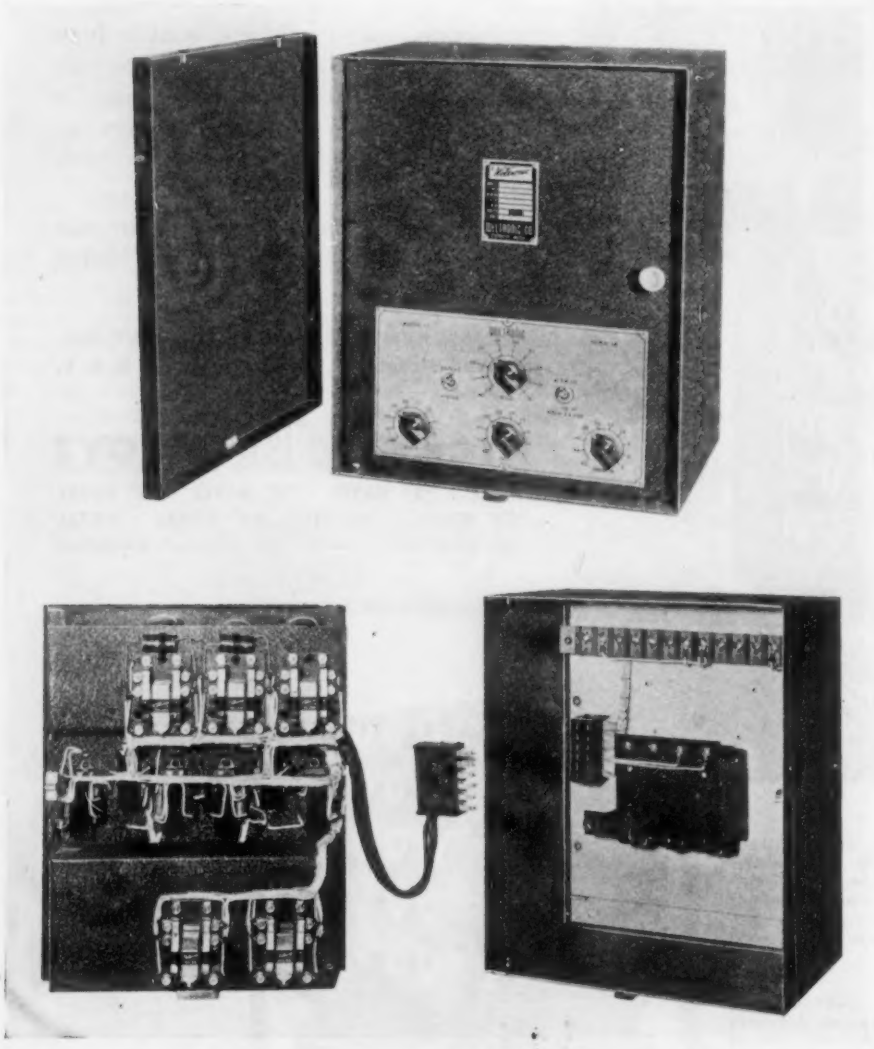
---

### NEW PLUG-IN TIMERS

Bringing to the welding industry a new conception of flexibility in resistance welder control, the new improved Weltronic Universal Timers with interchangeable "plug-in" type control panels make possible the conversion of timing controls to any of the N.E.M.A. standard types in only a few seconds. The design of the complete range of new weld and sequence timers incorporating a universal cabinet-and-power-supply unit and a series of individual control panels that can be interchanged without the use of tools or rewiring, permits any resistance welder to be immediately available for any type of welding within its capacity.

Use of a flexible cable, multi-point plug and receptacle for the interconnection between a control panel and the power supply unit plus a slotted-hinge type panel mount reduces the removal of a control panel to a simple swing-out, pull-plug, lift-off hand operation. Another panel of either the same or for a different type of welding can be set in just as easily. Provision of a spare control panel to quickly replace any one of a group in service permits the inspection or servicing of all welder controls to be performed without shutting down of any of the machines. Then, too, the servicing can be done away from the production department and where proper facilities are available.

The Universal power supply unit is adaptable for 115-, 230-, 575- or 460-volt, 50/60 a.-c. service by merely shifting one jumper. Entire unit is mounted on a single panel that can be removed, for servicing, by taking out four screws.



**New Weltronic Universal Timers Feature Interchangeable, "Plug-in" Type Control Panels Permitting the Conversion of Resistance Welders to Any of the N.E.M.A. Timing Types in a Few Seconds. Shown Here Is One Model with Tamperproof Cover Removed and a Control Panel, Providing "Squeeze," "Weld," "Hold" and "Off" Time Adjustments, Lifted Out of the Common Cabinet-and-Power-Supply Unit**

# Employment Service Bulletin

### POSITIONS VACANT

V-146. Young graduate engineer, some experence in welding and knowledge of metallurgy; Wanted for standardization work by national organization. Reply stating age, education, experience, draft status and salary desired.

V-149. Combination Welding Metallurgist and Inspector to take complete charge of inspection and quality control for company producing heavy trucks and similar equipment. Young engineering graduate with experience in welding metallurgy and machine production preferred. Excellent future with well-established medium sized company. Location—Cleveland, Ohio.

### SERVICES AVAILABLE

A-485. Two men with extensive background of experience in steel fabrication and prefabrication (one with 17 years' and the other, a graduate engineer, with 6 years' experience) available to take complete charge of shop. Work to be performed would include designing, estimating and organizing of plant if desired. Experience with Automatic Welding (Submerged Arc and Unamatic). Have worked together over a period of years in supervisory capacity in this line. Additional staff of experience tradesmen available when needed. No selling and guarantee of postwar positions expected. Any location.

A-486. Experienced as Welding Superintendent, Welding Foreman and Engineer. 20 years' experience in welded construction, both electric and acetylene. Familiar with pipe line construction, refineries, pump stations, tanks and shipbuilding. Speak and read Spanish fairly. Would like position in the Latin Americas.

A-487. Welding Metallurgist desires position. Age 27, single. Graduate B.S. Met. Eng. 1939. Graduate work in Metallurgy. Has been successfully employed in Metallurgical Research and Development work since 1940. Present position testing and research work on arc-welding electrodes.

---

### SUSTAINING COMPANIES

**Orr & Sembower, Inc.,** Reading, Pa., manufactures steel boilers, generating units for both high and low pressure. This company was organized in 1885 and has been continuously engaged in the manufacture of high-pressure steel boilers since that time. During the war, company manufactures boilers for use on mobile and portable laundries for the Army and Navy, and for a great many other services where steam is needed.

**Fruehauf Trailer Co.** manufactures commercial truck-trailers of various types and capacities.

Fruehauf is today the world's largest builder of truck-trailers, and its products are at work in over 100 different industries.

## "Here's the kind of hand protection every welder wants"

Ask a welder what he wants in a glove . . . and he'll tell you he wants protection with plenty of working comfort.

Take this pair of American Optical gloves. They're gun-cut—which means they have seamless palms—and the finger seams are flat to guard against chafing and blistering. And they're made of top quality chrome tanned cowhide that *stays* pliable. This can make the difference between an ordinary welding job and a good job. For *pliable* gloves give better control of both rod and torch. They help welders do faster, more uniform work.

The seams on AO gloves are located away from the parts that get the most heat and wear. That's why AO gloves can take plenty of punishment, too.

If you want to step up your welding production—and who doesn't these days—give AO gloves or mittens to *your* welders.

You'll find the Representative of your nearest AO Branch Office can help you choose the proper gloves and mittens from AO's welding line. Why not call him sometime today?

American Optical
COMPANY
SOUTHBRIDGE, MASSACHUSETTS

Fruehauf has nine plants—at Detroit, Mich. (main); Ft. Wayne, Ind.; Kansas City, Kan.; Los Angeles, Calif.; Cedar Rapids, Iowa; Springfield, Mo.; Omaha, Neb.; Birmingham, Ala.; Toronto. Can. All have been busy on military trailers, although the Detroit plant is now devoted almost entirely to civilian production.

Fruehauf operates 56 factory sales and service branches and is also represented by 10 distributors. Fruehauf's nation-wide service has been an important factor in helping to keep motor transport rolling under the handicap of restricted civilian production during the war.

### SUSTAINING MEMBER

**Oregon Shipbuilding Corp.**, located on the Willamette River in Portland, Ore., began production in May of 1941. It is under contract with the United States Maritime Commission and has, to date, produced 369 emergency ships for this war. Of these, 330 were the EC2 type Liberty Cargo; 32, AP3 type Victory Cargo, and 7 special type vessels. Contracts in the hands of the company include 23 more special type vessels and 63 AP3 Victory Cargo ships.

---

# List of New Members

September 1 to September 30, 1944

### BOSTON

**Buckley, Daniel J.**, (B), Buckley Iron Wks., 21 Christopher St., Dorcester, Mass.
**Dempsey, John C.**, (B), 101 Rugby St., Providence, R. I.
**Martin, Gerry G.**, (C), 27 Brastow Ave., Somerville, Mass.
**Pate, Lloyd W.**, (B), 12 Sheridan Ave., Medford 55, Mass.

### CANADA

**Hennessy, Burns L.**, (B), 132 Stinson St., Hamilton, Ont., Canada.
**McFarlane, William G.**, (C), 65 Higgins Ave., Winnipeg, Canada.
**Meyers, Waldy, C.E.R.A.**, (B), V-887—H.M.C.S. "Scotian," Halifax, N. S.

### CHICAGO

**Green, P. Arthur**, (C), 118 W. Fifth St., Hinsdale, Ill.
**Hammond, M. W.**, (C), 3108 W. 63rd St., Chicago, Ill.
**Jones, F. G.**, (B), Wall-Colmonoy Corp., 1444 W. Lake St., Chicago 7, Ill.
**Killian, Chas.**, (C), C. E. Phillips & Co., 332 So. Jefferson St., Chicago 6, Ill.
**McVey, David C.**, (B), International Harvester Co., 180 N. Michigan Ave., Chicago, Ill.

### CINCINNATI

**Mattingly, Chas.**, (B), Box 183, Lockland, Cincinnati 15, Ohio.

### CLEVELAND

**Collier, Donald C.**, (B), Euclid Road Mach. Co., 1362 Chardon Rd., Cleveland 17, Ohio.
**Jacobs, Jacob A.**, (C), 1914 W. 57th St., Cleveland 2, Ohio.
**King, J. Payne**, (B), Lincoln Electric Co., 12818 Coit Rd., Cleveland 1, Ohio.
**Stolitzka, Alexander F.**, (C), Frank J. Stolitzka & Son, 231 North Adams St., Akron 4, Ohio.
**Ulmer, W. L.**, (C), Superior Flux Co., 913 Public Square Bldg., Cleveland, Ohio.

### COLUMBUS

**Schlass, Jerome J.**, (C), 505 King Ave., Columbus, Ohio.

### CONNECTICUT

**Palmer, George**, (B), General Aircraft Equipment, Inc., So. Norwalk, Conn.

### DETROIT

**Adams, Kenneth H.**, (B), 2559 Carson, Detroit 9, Mich.
**Bossert, Arthur G.**, (B), City Pattern Fdry. & Mach. Co., 1161 Harper Ave., Detroit 11, Mich.
**Coulton, Fred J.**, (B), City Pattern Fdry. & Mach. Co., Detroit 11, Mich.
**Gibson, John G.**, (B), 24504 Colin Kelly, Centerline, Mich.
**Kelley, H. A.**, (B), City Pattern Fdry. & Mach. Co., 1161 Harper Ave., Detroit 11, Mich.
**Kushner, Michael**, (B), 5285 Chopin, Detroit, Mich.
**Moore, Jerry**, (B), Hotel Fort Shelby, Detroit 26, Mich.
**Partin, Bruce**, (B), 4359 Wayburn, Detroit 15, Mich.
**Reid, Vaughn C.**, (B), City Pattern Fdry. & Mach. Co., 1161 Harper Ave., Detroit 11, Mich.
**Shoup, Harold**, (B), 2053 Oakdale, Detroit, Mich.
**Tubbs, Owen**, (C), 132 Wallace St., Flint, Mich.
**Width, Robert B.**, (B), 1119 Batavia Ave., Royal Oak, Mich.
**Zimmerman, Richard E.**, (C), 7239 Kentucky Ave., Dearborn, Mich.

### INDIANA

**Young, Sam**, (C), Citizens Gas & Coke Utility, Prospect St. Plant, Indianapolis 9, Ind.

### KANSAS CITY

**Austin, H. R. E.**, (B), National Cylinder Gas Co., 1614 State Ave., Kansas City, Mo.
**Brown, C. E.**, (B), 7541 McGee St., Kansas City, Mo.
**Kreigh, R. C.**, (B), J. F. Pritchard & Co., 2200 Fidelity Bldg., Kansas City, Mo.

### LEHIGH VALLEY

**Chivinski, Joseph R.**, (B), Orr & Sembower, Inc., Reading, Pa.
**DeSimone, Ricardo D.**, (B), Orr & Sembower, Inc., Reading, Pa.
**Dunlap, John T., Jr.**, (B), Orr & Sembower, Inc., Reading, Pa.
**Dunn, James, Jr.**, (B), Orr & Sembower Inc., Reading, Pa.
**Ellis, Harry K.**, (C), 518 Washington Ave., Phoenixville, Pa.
**Kunsman, Winfield G.**, (C), Orr & Sembower, Inc., Reading, Pa.
**Leigemann, William**, (B), Orr & Sembower, Inc., Reading, Pa.
**Tuxhorn, D. B.**, (B), Orr & Sembower, Inc., Reading, Pa.

### LOS ANGELES

**Applegate, Robert R.**, (C), A. O. Smith Corp., 727 W. 7th St., Roosevelt Bldg., Rm. 452, Los Angeles, Calif.
**Bennett, William F.**, (C), 509 N. Williams Ave., Compton, Calif.
**Burton, Finis E.**, (C), 6143 Mayflower, Maywood, Calif.
**Hoferer, Gerald C.**, (C), 119 Shreve Rd., Whittier, Calif.
**King, Clarence**, (C), 1630 E. 2nd St., Apt 3, Long Beach 3, Calif.
**Smith, Vernon J.**, (B), 1909 S. Date St., Alhambra, Calif.

### MARYLAND

**Durham, Chas. E.**, (C), 757 W. Cross St., Baltimore 30, Md.
**Hanson, Donald F.**, (C), 1621 Kingsway Rd., Baltimore 18, Md.
**Hickam, James**, (C), 710 Pontiac Ave., Baltimore 25, Md.
**Lee, Francis M.**, (C), 2823 N. Calvert St., Baltimore 18, Md.

### MILWAUKEE

**Alexandroff, Paul**, (C), 645 So. 28th St., Milwaukee, Wis.

### MOBILE

**Andrew, H. O.**, (B), 105 Herndon Ave., Mobile 16, Ala.
**Kilgore, Jos. E., Lieut. Comndr.**, (B), 201 Monroe St., Mobile, Ala.

### NEW JERSEY

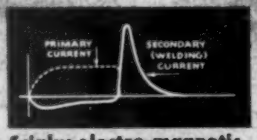
**Budzyko, John**, (C), 214 Alwood Rd., Clifton, N. J.
**Butler, L.**, (B), 55 Oliver St., New Brunswick, N. J.
**D'Amato, Raymond A.**, (B), 280 Randolph Ave., E. Rutherford, N. J.
**Knight, Donald**, (B), 26 Malvern Pl., Verona, N. J.
**Laune, Miss M. E.**, (C), 713 Sixteenth St., Union City, N. J.

# RESISTANCE WELDING

# *firsts* BY SCIAKY

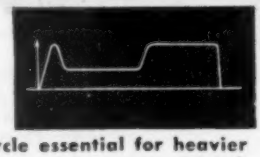
$H = I^2RTK$

*first* WITH STORED ENERGY



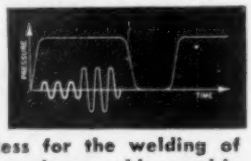

**First introduced in 1939 . . . Sciaky electro-magnetic Stored Energy principle found immediate acceptance in the aircraft industry. Special Preheating current, together with the Dynatrol arcless current interruptor are employed . . . the most efficient process for welding light alloys.**

*first* WITH VARIABLE PRESSURE



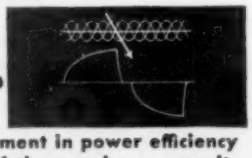
**An automatic pressure cycle essential for heavier gauges of aluminum . . . metal is precompressed, then pressure reduced during weld, followed by forging pressure after the passage of current . . . accounts for metallurgically sound welds. Cycle also used for forging on a.c. machines for steel.**

*first* TO WELD SCALY STEEL




**An exclusive Sciaky process for the welding of scaly and rusty steels . . . produces welds equal in consistency, uniformity and structure to those usually produced on clean pickled steels. Results in excellent tip life . . . permits comparatively rapid welding times for heavy stock.**

*first* WITH "3 PHASE-SINGLE PHASE" BALANCED POWER



**This revolutionary achievement in power efficiency utilizes all three phases of the supply . . . results in perfectly balanced load at near unity power factor, and decreased actual power demand. Reduces power installation and operating costs . . . provides ideal welding current for heavy gauges of steel.**

RESISTANCE WELDING . . . the fusion of metals by resistance to the passage of an electrical current . . . has come a long way since Professor Elihu Thompson patented the first spot welder in 1886. Since then design and performance have been steadily improved, and particularly in the past five years, developments have encouraged recognition of resistance welding as a major fabricating tool. *Sciaky has made notable contributions to this development.* Through constant research . . . refinements of weld quality, machine design and power efficiency have brought about wide acceptance of Sciaky welders. Consult us on your resistance welding problem.

**SCIAKY BROS.**

**4915 West 67th Street, Chicago 38, Illinois**

Offices in Los Angeles, Detroit, Cleveland and Washington
Representatives in Principal Cities
In England: Sciaky Electric Welding Machines, Ltd., London

**Peterkin, Roger,** (B), Peterkin Welding Supply Co., 344 Liberty St., Newburgh, N. Y.
**Urweider, Ernest,** (C), 92 Park View Ave., E. Paterson, N. J.

### NEW YORK

**Farrell, William J.,** (C), Grumman Aircraft Engrg. Co., Inc., Plant No. 2, Bethpage, L. I.
**Fisher, Victor,** (C), c/o Wohlrabe, 899 Hunts Point Ave., Bronx 59, N. Y.
**Valek, Edward J.,** (C), 298 Ridgewood Ave., Brooklyn 8, N. Y.

### NORTHERN NEW YORK

**Fitz, Hamlin,** (C), American Loco. Co., Schenectady, N. Y.
**Todd, C. D.,** (C), American Loco. Co., Schenectady, N. Y.

### NORTHWEST

**Epberg, C. E.,** (C), 721—6th St., S. E., Minneapolis 14, Minn.
**Erbstoesser, Aug. R.,** (C), 213 So. 17th Ave. E., Duluth, Minn.
**Wineland, Carl,** (C), 3815 Glendale Terrace, Apt. 5, Minneapolis, Minn.

### OKLAHOMA CITY

**Atwood, Marvin C.,** (C), 1624 S. W. 27, Oklahoma City, Okla.
**Biggs, Geo. E.,** (C), Mideke Supply Co., 100 E. Main St., Oklahoma City 2, Okla.
**Collier, Jewell,** (C), 626 S. E. 36th, Oklahoma City, Okla.
**Gee, Clovis,** (C), 3000 N. W. 24th St., Oklahoma City 7, Okla.
**Gordon, Royce M.,** (C), 1926½ N. Ellis, Oklahoma City, Okla.
**Harmon, V. D.,** (C), Oklahoma Oxygen Co., 15 North Ellison, Box 1521, Oklahoma City 1, Okla.
**Johnson, O. F.,** (C), 834 S. W. 35th, Oklahoma City, Okla.
**McDonald, Dallas,** (C), 1005 S. W. 31, Oklahoma City, Okla.
**Oldham, F. L.,** (C), 2200 S. W. 31, Oklahoma City, Okla.
**Preisker, T. H.,** (B), Welding Sales Co., 422 S. Walker, Oklahoma City, Okla.
**Watson, W. W.,** (C), 2301 S. W. 26th, Oklahoma City, Okla.
**Williams, R. L.,** (C), Mideke Supply Co., 100 East Main, Oklahoma City, Okla.

### PASCAGOULA

**Hudgens, Ruby Lee, Jr.,** (C), 1116 Williams St., Pascagoula, Miss.
**Rice, D. K.,** (C), 1404 E. Cleveland St., Pascagoula, Miss.
**Ward, J. M.,** (C), 1105 Market St., Pascagoula, Miss.

### PEARL HARBOR

**Bostrom, Edwin,** (C), Barracks 1, Navy 128, c/o F. P. O., San Francisco, Calif.
**Larkin, William K.,** (C), U. S. Navy Contonment, C10-513—16th St., Honolulu 62, T. H.

### PEORIA

**Bailey, Chas.,** (C), 723 W. Armstrong St., Peoria 5, Ill.
**Becker, Leonard A.,** (C), 417 E. Virginia, Peoria 4, Ill.
**Blue, Calvin G.,** (C), 709 Thrush, Peoria, Ill.
**Darling, Hugh,** (C), 404½ Maple St., Peoria, Ill.
**Dawson, Chester L.,** (C), Elmwood, Ill.
**Day, William L.,** (C), Box 83, Groveland, Ill.
**Dunford, G. S., Lieut.,** (B), Main St., Rochester, Ill.
**Hartseil, Clarence,** (C), R. R. 3, Peoria, Ill.
**Humphrey, F. E.,** (C), 203 Illinois St., Peoria Hgts., Ill.
**McEndollar, Willard,** (C), 1200 Fairoaks, Peoria, Ill.
**Nighswanger, Reginald,** (C), 601—4th St., Peoria, Ill.
**Shotton, Robert C.,** (C), 510 Oregon St., Apt. 105, Peoria, Ill.
**Stuart, Kenneth N.,** (C), 230 Dechman, Peoria, Ill.
**Suman, Joseph S.,** (C), 408 Kane St., Peoria 6, Ill.
**Tjaden, Henry R.,** (C), 1004 Griswold St., Peoria 6, Ill.
**Warner, Ronert A.,** (C), 117 Richard Ct., Creve Coeur, Ill.
**Work, Ivan S.,** (C), Box 51, El Paso, Ill.

### PHILADELPHIA

**Apter, Robert F.,** (C), Welding Service & Equip. Co., Philadelphia 21, Pa.
**Barteld, John F.,** (C), 34 Duncan Ave., Westville, N. J.
**Beebe, Erle J.,** (C), 2517 Pine St., Wilmington, Del.
**Bozzi, Nicholas,** (C), 502 So. 42nd St., Philadelphia, Pa.
**Bradley, Thomas W.,** (C), Dravo Corp., P. O. Box 589, Bldg. 1, Wilmington, Del.
**Crim, Caspar A.,** (B), 1434 E. Hunting Park Ave., Philadelphia 24, Pa.
**Del Prato, Anthony,** (B), 5332 Kershaw St., Philadelphia 31, Pa.
**Harlow, James W.,** (C), 3120 N. 15th St., Philadelphia 32, Pa.
**Hubach, Kenneth G.,** (B), Standard Electrode & Mfg. Corp., 40 East Wister St., Philadelphia 44, Pa.
**Jones, L. M.,** (C), 6 York Rd., Deerhurst, Wilmington, Del.
**Kinsey, Clifford P.,** (C), 812 Derwyn Rd., Drexel Hill, Pa.
**Layton, John B.,** (C), P. O. Box 589, Wilmington 99, Del.
**Light, John K.,** (C), Arcos Corp., 401 N. Broad St., Philadelphia, Pa.
**List, Walter G.,** (C), Arcos Corp., 401 N. Broad St., Philadelphia, Pa.
**Menalis, T.,** (C), 6219 Reedland St., Philadelphia, Pa.
**Spofford, William P.,** (C), Dravo Corp., Wilmington 99, Del.

### PITTSBURGH

**Bongartz, G.,** (B), R. D. 2, Sharpsburg, Pa.
**Bradburn, Leslie C.,** (C), 1052 Sarah St., Bridgeville, Pa.
**Chesney, William,** (B), 635—2nd St., Verona, Pa.
**Croco, Charles P.,** (B), 6909 Meade St., Pittsburgh, Pa.
**Dugan, W. S.,** (B), 225 Meridan St., Pittsburgh, Pa.
**Evans, W.,** (C), Dravo Corp., Neville Is., Pittsburgh 25, Pa.
**Green, G. L.,** (C), Dravo Corp., Neville Is., Pittsburgh 25, Pa.
**Gulling, Paul,** (C), Dravo Corp., Neville Is., Pittsburgh 25, Pa.
**Henisch, Valentine,** (B), 557 Church St., Verona, Pa.
**Heuschkel, Julius,** (B), Westinghouse Elec. & Mfg. Co., Research Lab., East Pittsburgh, Pa.
**Hilberg, Felix W.,** (C), 1514 Sylvan Terrace, Pittsburgh 21, Pa.
**Hopkins, J. M.,** (B), Scaife Co., Oakmont, Allegheny Co., Pa.
**Newton, D. B.,** (C), Dravo Corp., Neville Is., Pittsburgh 25, Pa.
**Nicholas, P. C.,** (B), Scaife Co., Oakmont, Allegheny Co., Pa.
**Scott, Charles P.,** (C), Dravo Corp., Neville Is., Pittsburgh 25, Pa.
**Simon, P.,** (C), Dravo Corp., Neville Is., Pittsburgh 25, Pa.
**Sprano, M.,** (B), 430 Freeport Rd., Blawnox, Pa.
**Turnbull, Edmund J.,** (C), Dravo Corp., Neville Is., Pittsburgh 25, Pa.

### PORTLAND, ME.

**Adams, Clarence,** (C), Route 1, Cumberland Center, Me.
**Brule, Roger A.,** (C), 46 Wilton Lane, Cape Elizabeth, Me.
**Burnham, Maurice L.,** (C), 21 Eleanor St., Portland 5, Me.
**Dorler, John F.,** (C), 296 Woodfords St., Portland, Me.
**Crosby, Bert,** (C), Towls St., Bar Mills, Me.
**Dudzik, John J.,** (C), 30 Cleaves St., Auburn, Me.
**Emery, Franklin C.,** (C), 175 Mechanic St., Westbrook, Me.
**Graffam, Edgar B.,** (C), Hollis Center, Me.
**Hatt, Maxwell D.,** (C), Box 370, Freeport, Me.
**Hatte, Dunbar N.,** (C), 4 Mechanic St., Freeport, Me.
**Hersey, Walter H.,** (C), 28 Wainwright Circle W., So. Portland, Me.
**Jenkins, Clarence A.,** (C), Box 283, Old Orchard, Me.
**Kimball, Henry A.,** (C), Box 55, R. F. D. 1, Cape Elizabeth, Me.
**Martin, Joseph E.,** (C), 140 Falmuith St., Portland 4, Me.
**McLain, Albert,** (C), 84 North St., Portland, Me.
**Miniutti, Edward L.,** (C), 88 McKinley St., So. Portland, Me.
**St. Ours, Omer,** (C), 33 Stone St., Biddeford, Me.
**Staires, Richard V.,** (C), 67 Brackett St., Portland, Me.
**Verrill, Howard A.,** (C), Box 20, Dry Mills, Gray, Me.

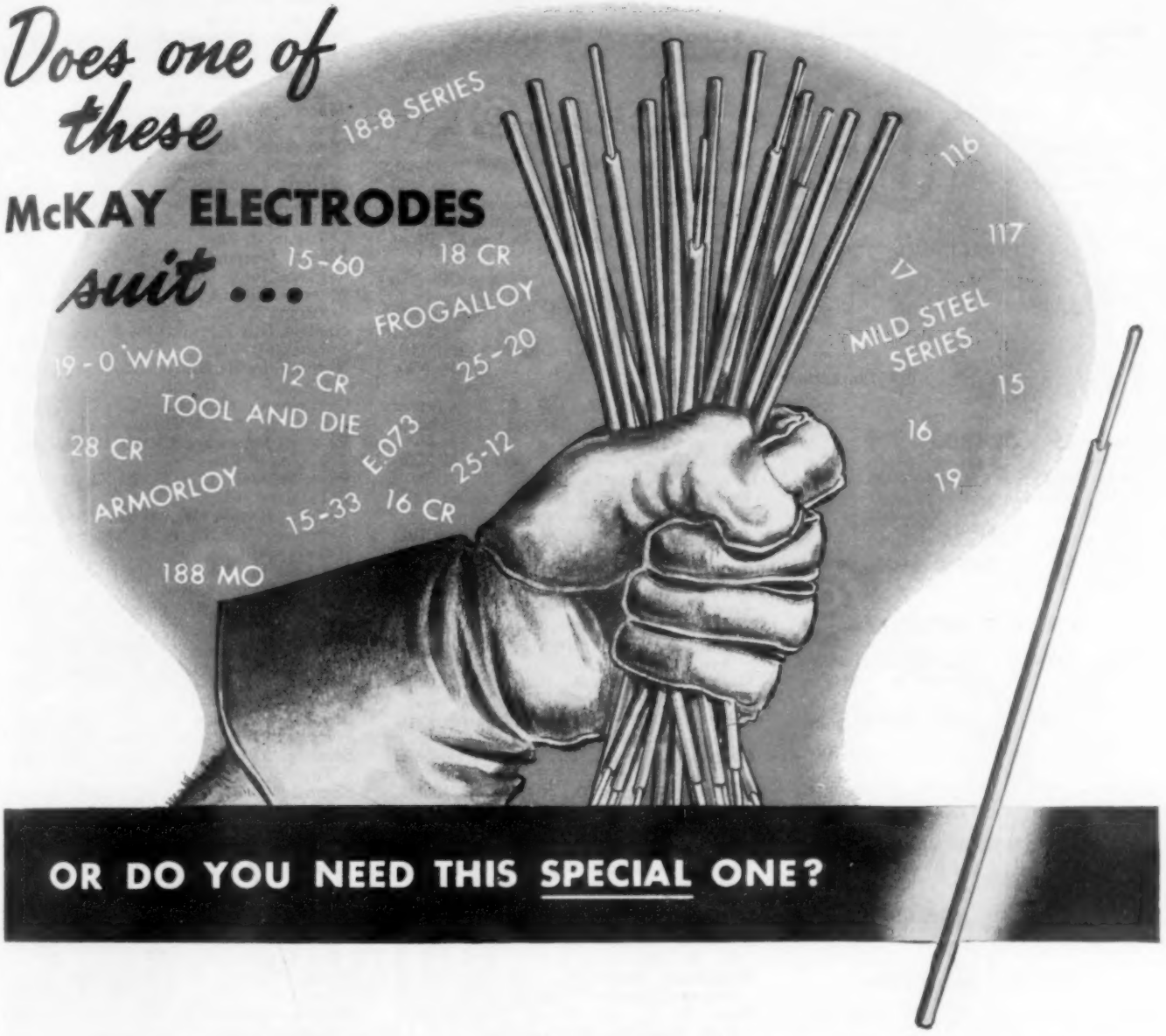
### PORTLAND, ORE.

**Hamm, Eugene,** (B), 512 N. E. Halsey, Portland, Ore.
**Hann, E. L.,** (A), 4411 N. E. Royal Ct., Portland, Ore.
**Hallett, John,** (A), Kaiser Co., Inc., Vancouver, Wash.
**Hoffman, Russell A.,** (A), Oregon Shipbldg. Corp., St. Johns Station, Portland, Ore.
**Hudspeth, Dan,** (C), 246 N. E. Lombard St., Portland, Ore.

### ROCHESTER

**Ashton, John J.,** (C), 144 E. Commercial, E. Rochester, N. Y.
**Brodman, Adam J.,** (C), 265 Cedarwood Terrace, Rochester 9, N. Y.
**Cerullo, John M.,** (C), 62 Estall Rd., Rochester 12, N. Y.
**Gorall, Edward** (C), 159 Curlew St., Rochester 13, N. Y.
**Laurer, Carl J.,** (C), 515 Chili Ave., Rochester, N. Y.
**Oehlbeck, William J.,** (C), 912 Portland Ave., Rochester 5, N. Y.

# *Does one of these* McKAY ELECTRODES *suit . . .*




## OR DO YOU NEED THIS SPECIAL ONE?

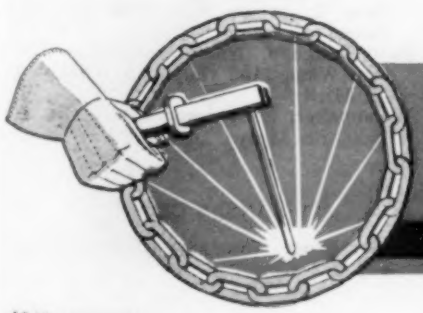
**McKAY GIVES YOU THE RESEARCHED LINE**

The McKay slogan, *"every* electrode a leader," is based on the determination to make every grade as good as painstaking research, careful manufacturing and unusually thorough step-by-step testing can make it. In addition to our own laboratories, an active fellowship in Mellon Institute fully qualifies McKay Electrodes to be called the *Researched Line.*

You will find in the *standard* line of McKAY Electrodes an exceptionally wide range of mild steel, alloy steel and stainless steel rods of analyses suited to almost every welding need. From a range of 40-odd mild, alloy and stainless grades, you can normally select an electrode which will exactly fit your requirements.

Occasionally, however, the need for a special electrode for a specific purpose will arise. In such cases, the facilities of our plant laboratory, working in collaboration with our Mellon Institute research department, will be placed at your service to develop the proper type of electrode for your particular job.

If available standard selections are not adequate, don't hesitate to ask for *this special* McKay service. Send full technical facts for our recommendations.



GENERAL SALES OFFICES: YORK, PA.

**THE McKAY COMPANY**
PITTSBURGH, PA.

WELDING ELECTRODES . . . COMMERCIAL CHAINS . . . TIRE CHAINS

ST. LOUIS

**Hubler, John W.,** (B), Washington University, Box 130, Skinker & Lindell, St. Louis 5, Mo.

SAN FRANCISCO

**Pilch, Albert,** (C), 281 Missouri St., San Francisco, Calif.
**Siegrist, August,** (C), General Delivery, Tiburon, Calif.

SYRACUSE

**Healy, Timothy M.,** (C), Box 1038, Syracuse, N. Y.

TIDEWATER

**Thrasher, R. W.,** (B), 6144 Powhatan Ave., Norfolk, Va.

TOLEDO

**Hees, Richard H.,** (B), Route 1, Port Clinton, Ohio.

TULSA

**Beil, W. E.,** (C), 2236 So. Marion, Tulsa, Okla.

WESTERN MICHIGAN

**Minnis, Lance H.,** (B), Box 632, Lansing 3, Mich.

WESTERN NEW YORK

**Abrams, George C.,** (C), 29 Royal Ave., Buffalo, N. Y.
**Kaluzny, John C.,** (C), 242 Woltz Ave., Buffalo 11, N. Y.

WICHITA

**Breeze, Garland E.,** (C), 602 N. Bluff, Wichita 6, Kan.
**Clark, Don M.,** (B), 1504 Matlock Dr., Wichita 6, Kan.

YORK-CENTRAL PENNA.

**Estep, Garland L.,** (C), 215 Green St., York, Pa.
**Kreeger, William A.,** (C), 215 Roosevelt Ave., York, Pa.

YOUNGSTOWN

**Nelson, Harry A.,** (B), 505 Lincoln Ave., Niles, Ohio.

NOT IN SECTIONS

**Altman, Cecil T.,** (C), 4307 Roland, Tampa 6, Fla.
**Aschinger, R. R.,** (C), Lincoln Elec. Co., 1319 Overton Pk., Memphis, Tenn.
**Barta, Joe W.,** (C), R. F. D. Box 47, Plant City, Fla.
**Bennett, Wm. L.,** (C), 5109—12th St., Tampa 3, Fla.
**Bondi, Manuel C.,** (C), 4007 Munro St., Tampa 5, Fla.
**Butler, James B., C.M.(AA)T.,** (B), Navy 147, Box C, c/o F. P. O., New York, N. Y.
**Chester, Elbert N.,** (B), E. N. Chester General Welding, Myers St., Rouseville, Pa.
**Cloud, William H.,** (C), 1502 E. K Nollwood St., Tampa 4, Fla.
**Dady, Ernest O.,** (C), 3515 Nebraska Ave., Tampa 3, Fla.
**Davis, Henry L.,** (C), R. F. D. Box 191, Lacoochee, Fla.
**Evans, William,** (C), 349 Whitton Dene, Isleworth, Mdx., England.
**Freeman, Sam G.,** (C), 201 W. Powhattan Ave., Tampa 4, Fla.
**Furman, George C.,** (C), 2905 Coachman Ave., Tampa 6, Fla.
**Galberaith, James R.,** (C), 310 W. Lambright, Tampa 4, Fla.
**Garrison, Clifford B.,** (C), 217 Maple Ave., Tampa 5, Fla.
**Garrison, Marvin,** (C), 306 W. Chelsea, Tampa 3, Fla.
**Garrison, Thomas D.,** (C), 702 E. Knollwood Ave., Tampa 4, Fla.
**Grantham, W. S.,** (C), R. F. D. 4, Box 2177, Tampa 7, Fla.
**Hardee, Woodrow W.,** (C), 4904—19th St., Tampa 5, Fla.
**Hart, Walter D.,** (C), 923—20th Ave. S., St. Petersburg 7, Fla.
**Harwood, William E.,** (C), 4700—21 St. N., St. Petersburg 6, Fla.
**Hepinstall, Leslie E.,** (C), 511½ E. Hillsborough Ave., Tampa 4, Fla.
**Hiler, W. S.,** (B), W. S. Hiler & Co., 2123 Texas St., El Paso, Tex.
**Jardine, Alexander,** (B), Jessop & Co. Ltd., 93 Clive St., Calcutta, India.
**Jordan, Nelson,** (C), 5111 Nebraska Ave., Tampa 3, Fla.
**Kennedy, Raymond E.,** (C), 2507 Fig St., Tampa 6, Fla.
**Landruni, James W.,** (C), 8311 Florida Ave., Tampa 4, Fla.
**Macon, Walter T., Jr.,** (C), 1003 Crenshaw St., Tampa 4, Fla.
**McKenzie, Audley H.,** (C), 1427—49th Ave. N., St. Petersburg 6, Fla.
**McNair, Claudius N.,** (C), R. F. D. Box 705, Tampa 5, Fla.
**McWilliams, Carl,** (C), 106 W. Jean St., Tampa 3, Fla.
**Moffitt Benjamin B., Jr.,** (C), Mirasol Plaza Hotel, Davis Is., Tampa 4, Fla.
**Moore, Clifford E.,** (C), 3006 Caracas, Tampa 3, Fla.
**Nichols, Guy F.,** (C), 1304 S. Moody Ave., Tampa 6, Fla.
**Norman, Leslie H.,** (C), R. F. D., Valrico, Fla.
**Overstreet, Abraham A.,** (C), 518 E. Frierson, Apt. 2, Tampa 3, Fla.
**Padgett, James E.,** (C), 410 W. Violet St., Tampa 3, Fla.
**Pass, Russell J.,** (C), Rt. 2, Box 772, Tampa 5, Fla.
**Penick, Harold W., C.M.,** (B), U.S.S. *Prairie*, U.S.N., F. P. O., San Francisco, Calif.
**Pittman, M. M.,** (C), 1016 E. Hamilton Ave., Tampa 4, Fla.
**Pollard, T. H.,** (C), 307 E. Cayuga St., Tampa 3, Fla.
**Rentz, Franklin T.,** (C), 412 Henderson Ave., Tampa 1, Fla.
**Roberts, Robert P.,** (B), 3727 Orlando Circle, Jacksonville 7, Fla.
**Scarffe, Raymond F.,** (B), Pier View, Hythe, Near Southampton, England.
**Stockey, D. G.,** (C), Rt. 1, Box 529, Tampa, Fla.
**Summerlin, Wm. L.,** (C), 3603 Roland St., Tampa 6, Fla.
**Teston, Andrew C.,** (C), 7204 Navin St., Tampa 4, Fla.
**Tharp, J. W.,** (C), 1027 Emma St., Tampa 5, Fla.
**Turner, Alton,** (C), 1211 Crenshaw, Tampa, Fla.
**Valleroy, Prville A.,** (C), 3705 Arlington St., Tampa 4, Fla.
**Webb, William H.,** (C), U.S.S. *Black Hawk*, c/o F. P. O., San Francisco, Calif.
**Whalen, Richard D.,** (C), 2510 Caracas, Tampa 3, Fla.
**Wortham, Robert F.,** (C), 805 E. Osborn Ave., Tampa 3, Fla.

# Members Reclassified

During Month of September

CHICAGO

**Griffith, Mansfield,** (from C to B), 11131 Parnell Ave., Chicago 28, Ill.
**Nichols, Wm. W.,** (from C to B), 2727 Ross Ave., Highland, Ind.

CLEVELAND

**Jarms, J. J.,** (from D to C), 15818 Chadbourne Rd., Shaker Heights 20, Ohio.
**Pfabe, Leonard C.,** (from D to C), P. O. Box 318, Fairview Ave., Atwater, Ohio.

COLUMBUS

**Waldvogel, Robert K.,** (from D to C), 135 Lafayette Ave., Urbana, Ohio.

DETROIT

**Brown, E. B.,** (from C to B), 174 So. Clark St., Detroit 9, Mich.
**Hutton, Lyle P.,** (from C to B), Welding Sales & Engr. Co., 8750 Grinnell, Detroit 13, Mich.
**Last, Albert J.,** (from C to B), Welding Sales & Engrg. Co., 8750 Grinnell, Detroit 13, Mich.
**Reid, Vaughan,** (from C to B), City Pattern Wks., 1165 Harper Ave., Detroit 11, Mich.
**Wanamaker, E. George,** (from C to B), 16609 St. Marys, Detroit 27, Mich.

KANSAS CITY

**Calder, Bruce,** (from D to C), 1419 Byron, Topeka, Kans.

# *Complete fusion of stud to metal in less than 1/2 second!*

*Cutaway view of stud after etching with Nital*

# Nelson *Electric Arc* Stud Welding...

**Now used by more than 460 industrial plants and shipyards, the Nelson Stud Welder is saving up to 75% of the time and material required when securing studs or bolts by slower methods.**

**The variety of Nelson Studs will fit every industrial requirement. The studs are *automatically* end-welded by the Nelson Stud Welder. No previous experience is necessary to operate it, for the timing cycle of the welding is completely controlled and consistent results are obtained. The welds produced *are stronger than the stud itself!***

*The Model "H" Nelson Stud Welder*

*Write for complete details and catalog to:*

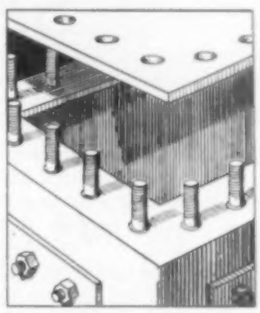
**NELSON SPECIALTY WELDING EQUIPMENT CORPORATION**

**Dept. J, 440 Peralta Avenue**
**San Leandro, California**

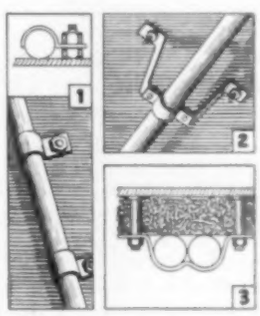
*Eastern Representative: Camden Stud Welding Corp. Dept. 22, 1416 South Sixth St., Camden, N. J.*

## TYPICAL STUD APPLICATIONS

**Metal Lath**—Studs are welded and insulation impaled or sprayed over them. Slotted washers secure the insulation. The metal lath is laid and secured by bending over the stud head. It lies flat and is easily covered with plaster.



**Inspection covers** of all types can be secured with Nelson Studs. No drilling holes through casings, or hand welding studs. Studs are automatically welded in less than ½ second. No leaking or loosening.




**Wiring, conduit, and pipe** are quickly secured. Here illustrated are a few methods: 1. Securing conduit. 2. Securing pipe (single and multiple runs). 3. Securing wiring of all kinds over soft insulation material.

MILWAUKEE

**McClay, Ervin,** (from D to C), 1114—16th Ave., So. Milwaukee, Wis.

NEW JERSEY

**Spicer, K. M.,** (from C to B), International Nickel Co., 67 Wall St., New York, N. Y.

NEW YORK

**Higgins, Theodore R.,** (from C to B), American Inst. of Steel Constr., 101 Park Ave., New York 17, N. Y.

NORTHWEST

**LeJeune, L. L.,** (from C to B), 3932 Xenia Ave., Robbinsdale 12, Minn.

**Peterson, Harold J.,** (from D to C), 3528—36th Ave. So., Minneapolis 6, Minn.

PORTLAND, ORE.

**King, Ivan C.,** (from C to B), 4737 N. E. 29th, Portland 11, Ore.

ROCHESTER

**Parker, Jack,** (from D to C), 558 Flint St., Rochester 11, N. Y.

SOUTH TEXAS

**Elliott, R. J.,** (from C to B), 5240 Jefferson, Houston 3, Tex.

TULSA

**Swan, Felix D.,** (from D to C), 1162 Walnut St., Muskogee, Okla.

WASHINGTON, D. C.

**Boyd, Henry I.,** (from C to B), 304 Palen Ave., Hilton Village, Va.

**Darby, James L.,** (from D to C), 3082 Clinton St., N. E., Washington 18, D. C.

NOT IN SECTIONS

**Gatchell, George D.,** (from C to B), 1325 E. Creighton Ave., Fort Wayne, Ind.

**Henry, Dallas T.,** (from D to C), 920 Montgomery Ave., Ashland, Ky.

---

# SECTION ACTIVITIES

## BOSTON

Although the regular meeting night of this Section is the second Monday of the month, it was necessary to open the season with a meeting on the third Monday, October 16th. At this dinner meeting Philip Drinker, Professor of Industrial Hygiene, Harvard University School of Public Health, and Chief Health Consultant to the U. S. Maritime Commission, spoke on "Health Problems in Welding." Dr. Drinker described the toxic products from welding and their control and significance in building ships. He also showed his sound film "Welders—To Your Health."

The Bureau of Aeronautics, U. S. Navy Department's sound film "Aircraft Welding" was also shown.

## CHATTANOOGA

The Chattanooga Section held its first meeting of the fall season on Friday evening, October 6th, in the Auditorium of the Electric Power Board Building. A good attendance turned out to welcome George F. Wolfe, Welding Consultant of the Dravo Corp. of Wilmington, Del., who talked on "Production Line Welding in Ship Construction." Mr. Wolfe's talk was illustrated by slides and a lively question and answer period followed.

One of General Electric Co.'s films on a.-c. welding was shown and a rising vote of thanks was extended the Program Chairman, Pembroke Leach, for the splendid way in which he lined up speakers and entertainment for meetings to be held during the fall and winter season. It is anticipated that the Chattanooga Section will have its most successful year in its history as the result of the interest being shown in the SOCIETY and its accomplishments.

## CHICAGO

If the September meeting of the Chicago Section A.W.S. is any indication as to the attendance and interest in welding in the Chicago area the Chicago Section will undoubtedly have its largest year during the 1944–45 season.

This meeting was started with a dinner held at Hyler's Restaurant which was attended by some 60 members and guests.

The speaker of the evening was Frank E. Thompson, Jr., Thompson Engineering Co., Grand Rapids. He spoke on the subject "Repair Welding of Naval Craft at Pearl Harbor on and After Dec. 7, 1943." Mr. Thompson presented an interesting and enlightening story, giving his audience background history of the Hawaiian Islands, telling somewhat of the events that led to the Jap attack on Pearl Harbor, and then discussed in considerable detail the part that welding and cutting played in the reclamation of the Naval fleet so seriously damaged by the enemy. Mr. Thompson's presentation was followed by a lively discussion period.

This meeting was one of the largest ever held by the Chicago Section with more than 360 guests and members in attendance.

## CONNECTICUT

At the present time there is a movement afoot to have the Connecticut Section divided into two sections; one to be known as the Hartford Section, and the other the Bridgeport Section.

The purpose of this division is to make it easier for the members to attend meetings. With the present arrangement, distances between Hartford, New Haven, Bridgeport and Waterbury make it decidedly difficult for members in the southern section of Connecticut to attend meetings in Hartford and vice versa. It is the belief of those in favor of this movement that it will enable the AMERICAN WELDING SOCIETY to better serve more people.

Considerable interest in this movement has been indicated in the Hartford district and it is expected that there will soon be a strong group in that territory.

At present, most of the officers of the Connecticut Section seem to come from the southern part of the state and it is expected that they will continue to further the work of the SOCIETY in this district.

## KANSAS CITY, MO.

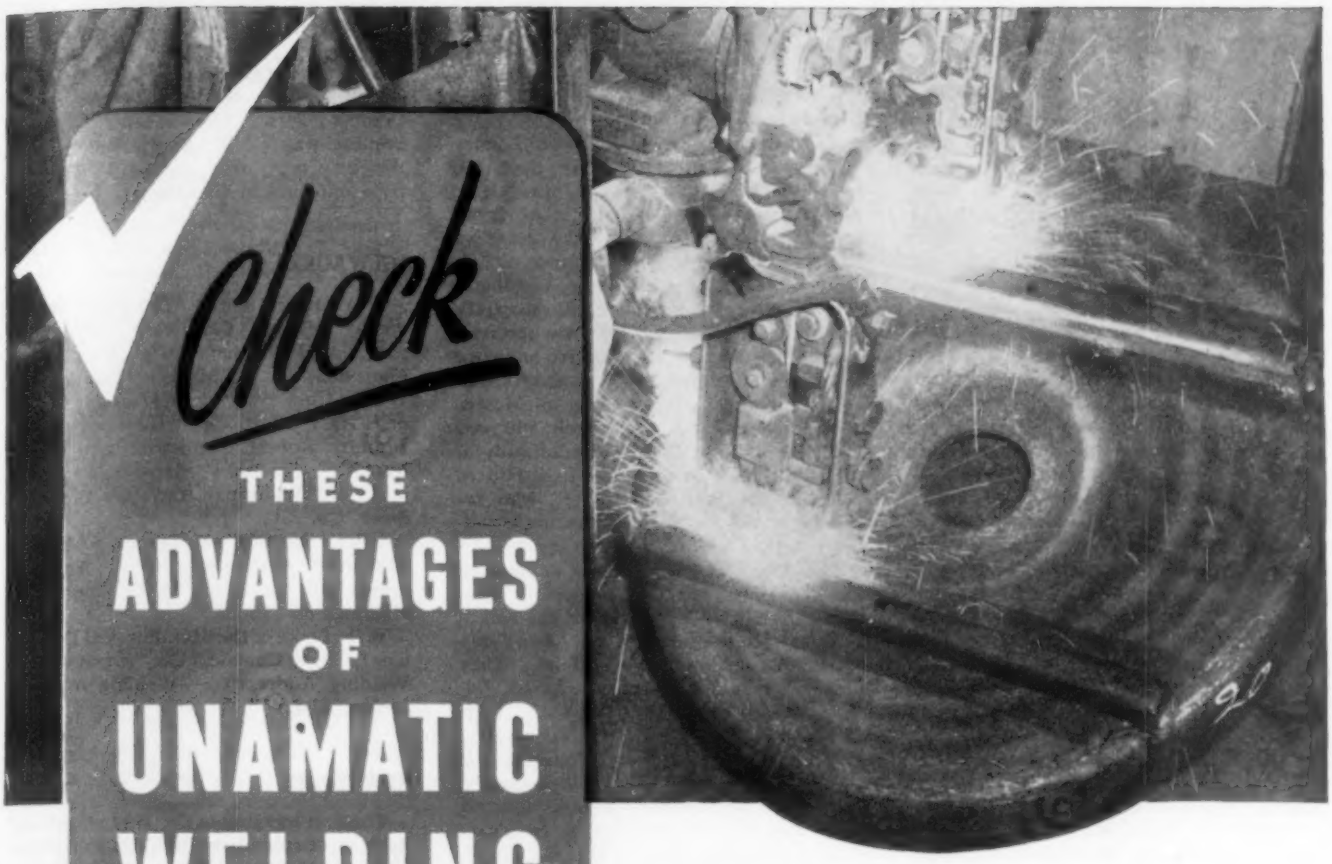
James F. Lincoln, President of The Lincoln Electric Co., addressed the September 12th meeting of the Kansas City Section, to which members of local sections of technical societies and several businessmen's organizations were invited. The meeting was very interesting and the many questions asked Mr. Lincoln showed that the audience appreciated the opportunity of hearing this outstanding speaker. This was one of the largest meetings held by the Section.

Mr. Goldby, of the Chicago Bridge and Iron Co., spoke on "Designing for Welding" at the October 24th meeting.

The November meeting will be held on the 21st, with T. B. Jefferson, Editor of *The Welding Engineer*, as speaker. His subject will be "Welding in the Postwar World." The meeting will be held in the Pine Room at the Union Station. Dinner will be served at 6:30 P.M.

## LEHIGH VALLEY

The first meeting of the 1944–45 season of the Lehigh Valley Section was held on October 2nd at the Hotel Bethlehem,



# Check THESE ADVANTAGES OF UNAMATIC WELDING

★ ★ ★ ★

✓ FASTER

✓ BETTER

✓ LOWER COST

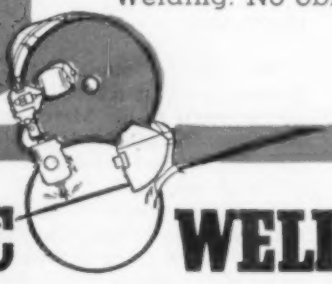
ARC WELDING

Faster . . . because with Unamatic the same number of welders can turn out 2 to 3 times as much work as when manually operated equipment is used.

Better . . . because Unamatic provides these performance advantages: mechanical control after operating procedure has been established, thus eliminating human variables . . . a continuous uninterrupted pass of uniformly high quality . . . exact repetitive duplication.

Lower cost . . . because of greatly increased production with the same number of welders and a 15 to 25% savings in materials used through elimination of stub end losses. (Unamatic wire and tape are in coil form.)

Write or wire today for complete information. Find out how your plant can benefit from these 3 important advantages of Unamatic Welding. No obligation, of course.



CONTROLLED QUALITY **UNAMATIC WELDING** CONTINUOUS PRODUCTION

UNA WELDING INC. • 1615 COLLAMER AVE. • CLEVELAND 10, OHIO

Bethlehem, Pa. C. E. Jackson, Metallurgist, Naval Research Laboratory at the Anacostia Station, Washington, D. C., presented a lantern-slide illustrated talk on "The Magic of Welding." The talk was begun and concluded with feats of magic.

Mr. Jackson presented data on laboratory tests which aid in the explanation of structural failures. For example, data on the effect of temperature and aging on ductility aid in the explanation of some of the welded ship failures. Mr. Jackson predicted that future welded structure will use revised designs particularly in the application of composite structure, better base materials and greatly improved electrodes.

Chairman Kenworthy directed attention to the interesting schedule of subjects and speakers which will be presented in the 1944–45 season. The members were urged to voice their choice of subjects for the programming of the Panel Discussion Meeting which is scheduled in February. Special questionnaires will be mailed to each member with their November bulletin.

## LOS ANGELES

The first regular monthly meeting for 1944–45 of the Los Angeles Section was held on Thursday evening, September 21st, at Scully's Cafe. The first subject presented was "Spot Welding Aluminized Steel" by Harry Brown, Instructor in Aeronautical Engineering, University of Texas, also with Hughes Aircraft Co.; the second subject was "Helium Shielded Welding of Stainless Exhaust Collectors" by Francis Stevenson of Lockheed Aircraft Co.

The speaker for the October meeting was W. J. Poehlman, Chief Spectrographer from the A. O. Smith Corp. of Milwaukee. Mr. Poehlman spoke on 'Spectrography Applied to Welding."

## LOUISVILLE

The text, Steel. Campbell—*Welding Metallurgy*, published by the AMERICAN WELDING SOCIETY, was used at the University of Louisville in a lecture and demonstration laboratory course entitled "Physical Metallurgy for Shipbuilding Industry." This course was designed at the request of the Jeffersonville Boat & Machine Co., by Thomas Hoeppner, Personnel Training, for their employees and those of their Subcontractors. The prerequisites of high-school graduation or equivalent and recommendation by employers were necessary. Emphasis was given to the metallurgy of welding.

The teachers were Dr. R. C. Ernst, head of the Chemical Engineering Dept., and Dr. C. C. Williams, Associate Professor of Chemical Engineering. The students were Theodore Lewis, Lyman L. Hall, Frank E. Carroll, Robert L. Meredith, Ray F. Brummet, George McMonigle, Shelby T. Dewess, Ellis Meador, Ernest E. Cozad, C. E. Smith, J. W. Hardy, W. J. Winter, R. W. Evans, H. R. Craynon, W. C. Sowle, J. T. Brendel, W. B. Floyd, all of the above employees of the Jeffersonville Boat & Machine Co., also Arnold T. Van Etten employee of the Griffen Co., W. M. Hoefelman of Kilroy & Co., Inc., and Nelson Rath, Navy Inspector attached to the Jeffersonville Boat & Machine Co.

The Louisville Section's Annual Dinner Meeting was held on Tuesday, Sept. 26, 1944, with G. N. Sieger, President, S.M.S. Corp., Detroit, Mich., as guest speaker with his subject "The Story of Resistance Welding" and movie, "Aircraft Production Processes; Welding." Mr. Sieger capably and enthusiastically delivered his message which was received by an attentive and appreciative audience of some two hundred members and friends. Dan Whipping, pinch-hitting, as Master of Ceremonies for R. E. Fritsch, whipped things up and came through admirably in the "pinch" in introducing Don Hill of "In the Sports Arena Fame" who re-enacted one of his radio announcing broadcasts to the enjoyment of the guests.

The Master of Ceremonies announced the new officers who had recently been elected through the medium of the ballot. The new officers took their "bow" appropriately with much acclaim. They were *Chairman*, Theodore H. Lewis, Jeffersonville Boat & Machine Co.; *Vice-Chairman*, E. H. Dilley, Tube Turns, Inc.; *Treasurer*, William Dettmar, American Air Filter Co.; *Secretary*, H. L. Hochstrasser. The Board of Directors were as follows: J. C. Ray, Louisville Bridge & Iron Co.; E. F. Schultz, L. & N. R.R. Co.; G. W. Plinke, Henry Vogt Machine Co.; E. L. White, Ky. Mfg. Co.; Murray Davis, Jeffersonville Boat & Machine Co.; J. C. Pluckebaum, Louisville Electric Mfg. Co.

Among the guests were Dr. C. C. Williams, Associate Professor of Chemical Engineering, University of Louisville and R. F. Brandt, Vice-President, Jeffersonville Boat & Machine Co., who made a few congratulatory remarks. Lieut. E. A. Taylor, a U. S. Navy Representative, stationed at the Jeffersonville Boat & Machine Co., also made a few remarks. Some 25 firms, practically all engaged in war industry, were represented.

Our guest speaker, G. N. Sieger, was presented with a "Certificate of Appreciation" which read in part as follows: "For the Comprehensive Interpretation of the Subject Matter. For Giving so Generously of your Talent. For Welding Together the Human Element Involved, therefore Creating Better Understanding and Cooperation." The presentation was made by Chairman Theodore H. Lewis.

## MARYLAND

The 1944–45 season of the Maryland Section opened with a well-attended meeting on August 18th. More than twice the usual number attended dinner and this group was swelled to a fine audience for the technical meeting.

G. O. Hoglund, Welding Engineer, Aluminum Co. of America, presented the paper, "The Welding of Aluminum," with ample illustration in the form of movies and slides. Mr. Hoglund's paper proved of interest, evidenced by the many and varied questions put to him in the question period.

The October meeting was eliminated in deference to the annual meeting in Cleveland.

The next regular meeting of the New Jersey Section was held on Tuesday, October 24th. The speaker for the evening was C. W. Steward of Curtiss-Wright Corp., who discussed "Welding Developments in the Aircraft Industry."

## MILWAUKEE

New officers of the Milwaukee Section are as follows: *Chairman*, Carl Malmberg, Allis-Chalmers Mfg. Co.; *Vice-Chairman*, G. F. Meyer, Machinery & Welder Corp.; *Secretary-Treasurer*, Chauney Hart, Heil Co.; *Directors*, Elmer Brandt, Robert Bennewitz and Davis Lynch; *Chairman Membership Committee*, R. Walbridge, Lakeside Bridge & Steel Co.

Dinner meeting was held on September 22nd at the Ambassador Hotel. An after-dinner talk was given by Dr. Samuel G. Higgings on "India."

W. S. Loose of the Metallurgical Department, Dow Chemical Co., presented the Welding Address on "Welding of Magnesium Alloys."

## NEW JERSEY

The first meeting of the 1944–45 season, held on September 19th at the Essex House in Newark, N. J., was very well attended and the Dinner immediately preceding the General Meeting drew a larger crowd than any in the history of the New Jersey Section. W. J. Conley, Welding Consultant for Lincoln Electric Co. and the speaker of the evening, gave a practical, illustrated lecture on designing for economical and efficient distribution of metal in welded machinery and structures. The address was very well received as evinced by the discussion following it. As usual, the Information Please Session, a period for the asking and answering of general welding questions, was held for one-half hour prior to the regular meeting.

The officers, duly elected last May, who have taken office for the current year, are: *Chairman*, G. W. Nigh; *Vice-Chairman* K. W. Horsman; *Secretary-Treasurer*, F. G. Flocke; *Program Committee Chairman*, R. T. Pursell; *Membership Committee Chairman*, A. C. Axtell; *Advisory Committee Chairman*, F. C. Fyke.

## NEW YORK

The regular monthly technical meeting of the New York Section was held on Tuesday, October 10th, at the Engineering Societies' Building. Subject for the evening was stainless steel, with J. Tangel, Grumman Aircraft Engineering Corp., Bethpage, L. I., as Technical Chairman.

John K. Fetcher, Plant Engineer Edward G. Budd Manufacturing Co., Philadelphia, Pa., spoke on the subject "The Welding of Stainless Steel Structures." Mr. Fetcher covered recent developments in the field of stainless steel welding. His talk was well illustrated by numerous lantern slides.

The meeting began with the regular half-hour question and answer period conducted by H. O. Klinke, Air Reduction Sales Co., Jersey City, N. J.

## NORTHWEST

Frank E. Thompson, Jr., of the Thompson Engineering Co., Grand Rapids, Mich., spoke on "Salvage Operations at Pearl Harbor on and After Dec. 7, 1941," at the September 21st meeting of the Northwest Section.

A motion picture entitled "Air Forces Report," produced by the Army Air Corps, was also shown.

The October 12th meeting consisetd of a double-feature program. Feature No. 1 was John Mikulak, Mechanical Engineer of Electric Machinery Mfg. Co., who discussed "Design of Welded Machinery," which was illustrated by lantern slides. Feature No. 2 was a General Electric motion picture in full color and sound "The Story of A.-C. Welding."

It is planned to hold all meetings in the Men's Lounge of the Coffman Memorial Union, University of Michigan.

## OKLAHOMA CITY

J. F. Lincoln, President of the Lincoln Electric Co., Cleveland, Ohio, was the guest speaker for the Annual Kick-Off Meeting of the Oklahoma City Section held on September 14th in the Municipal Auditorium, Little Theatre. The attendance at this meeting exceeded three hundred.

Mr. Lincoln briefly discussed some of the major developments made in welding during the war and also the plans of the industry for postwar welding. Following this, Mr. Lincoln proceeded with his main address, "Governmental Control vs. Private Enterprise."

The following is the program of meetings to be held by the Oklahoma City Section at the Biltmore Hotel:

Nov. 23, 1944—Subject: "Welding in Postwar World"; Speaker: T. B. Jefferson, Editor, *The Welding Engineer*, Chicago.

Dec. 21, 1944—Subject: "Low Temperature Brazing"; Speaker: M. C. Robbins, Handy & Harman, Chicago.

Jan. 18, 1945—Subject: "Aircraft Welding"; Speaker: P. H. Merriman, The Glenn L. Martin Co., Baltimore.

Feb. 22, 1945—Subject: "Shipyard Welding and Cutting"; Speaker: W. E. Whitehouse, Defoe Shipbuilding Co., Bay City, Mich.

March 22, 1945—Subject: "Railroad Welding"; Speaker: J. W. Kenefic, Airco Railroad Sales Dept., Chicago.

April 19, 1945—Subject: "Hard-Facing"; Speaker: George F. Staley, Sales Manager, Stoody Co., Whittier, Calif.

May 17, 1945—Subject: "Stain-Steel"; Speaker: Dr. V. N. Krivobok, International Nickel Co., N. Y.

## PASCAGOULA

Another new Section has been added. The organizational meeting of the Pascagoula Section was held on August 15th. and the following officers were elected: *Chairman*, W. B. Bowen; *Vice-Chairman*, C. M. Dick; *Secretary-Treasurer*, Milton Forman; *Members-at-Large*, Tom Dawson, Sydney Swan and A. M. Swigert.

It was decided that the regular meetings would be held on the next to the last Tuesday of every month.

The September meeting was held on the 18th and a very interesting talk on the Weldability of Metals was given by Tom Dawson, Chief Metallurgist for the Ingalls Shipbuilding Corp.

LaMotte Grover of the Air Reduction Sales Co., New York, was guest speaker at the October 31st meeting.

## PEORIA

The opening meeting of the Peoria Section, held September 20th at the Jefferson Hotel in Peoria, was addressed by J. B. Quigley, Superintendent of Welding of the Graver Tank & Mfg. Co., E. Chicago, Ind., on the subject: "Submerged Arc Process of Automatic Electric Welding."

The meeting was a dinner meeting and was attended by 110 members and guests who, by their attentiveness and ready questions at the question period, indicated that Mr. Quigley's presentation of this subject was a real contribution to the program of the Peoria Section.

Mr. Quigley drew some very interesting illustrations on the blackboard, and also had some fine examples with him which were very interesting to the group.

## PHILADELPHIA

The Philadelphia Section of the AMERICAN WELDING SOCIETY will continue to hold Panel Discussion meetings at the Philadelphia Engineers' Club during the coming winter as has been done most successfully for the past two seasons. It is now planned to have six meetings, the first of which was held on Monday, October 23rd, but which, thereafter, will be held on the 4th Friday of the month of November, January, February, March and April. It is possible that additional meetings will be scheduled from time to time if circumstances permit.

The first regular monthly meeting of the season was held on Monday, September 18th, at the Engineers' Club, Philadelphia. Prof. J. R. Stitt, Welding Engineering Department, Ohio State University, presented an interesting address on "Welding Engineering in Our Universities."

## PUGET SOUND

Starting the 1944–45 season of the Puget Sound Section Program Committee announced the policy of conducting its monthly Section meetings on the last Wednesday of each month, at the Gowman Hotel, at 7:00 P.M.

The first meeting of the fall quarter was held on September 27th. "Erection and Welding Sequence in Ship Construction" was presented by M. Q. Cellers, Superintendent of Welding, Todd Pacific Shipbuilding Co., Seattle.

The second meeting was held on October 25th. "Endurance of Metals Under Repeated Stresses" was presented by Alex Finlayson, Technical Director of Foundry, Pacific Car and Foundry Co.

The third meeting will be held on November 29th. "High-Strength Spot-Welded Joints" will be presented by Marshall Crawford, Process Engineer, Boeing Aircraft Co.

The following are the newly elected officers of the Section: *Chairman*, George L. Tepley, Webster Welding Co.; *Vice-Chairman*, A. L. Patnik, Lincoln Electric Co.; *Treasurer*, Clark Brown, Todd Pacific Shipyards, Tacoma; *Secretary*, Joe Barr, Todd Pacific Shipyards, Seattle.

## ROCHESTER

The 1944–45 meetings and lectures of the Rochester Section will be held at Lower Strong Auditorium, University of Rochester River Campus, the first Thursday of each month.

The speaker for the first meeting held on October 5th was Fred L. Plummer of the Hammond Iron Works, Warren, Pa. His subject was "Field Welded Pressure and Variable Volume Tanks for War Industries."

The speaker at the November 2nd meeting was R. F. Helmkamp, Applied Engineering Department of the Air Reduction Sales Co. The subject was "Recent Developments in Machine Gas Cutting."

The December 7th meeting will take place in the laboratory of the University of Rochester and physical tests will be made on welded test bars which should prove of much interest to the operator as he will understand more thoroughly what is meant by tensile strength and other terms used when talking about certifying a welder.

## SAN FRANCISCO

On Friday, August 25th, at the Lakeside Country Club, under the auspices of L. W. Delhi, of the Western Pipe and Steel Co., the Executive Committee of the Section along with other prominent members of the Section, met at an informal meeting, to which were invited representatives of The American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

This meeting was called for the purpose of bringing about closer relationships between the local Sections of the AMERICAN WELDING SOCIETY and the American Society of Mechanical Engineers and American Institute of Electrical Engineers.

The September meeting of the AMERICAN WELDING SOCIETY, San Francisco Section, was held at the Claremont Hotel, Ashby Ave. and Tunnel Rd, Berkeley, Calif., on Monday, September 25th, Chairman C. M. Doggett presiding.

There were approximately 100 members and guests in attendance.

R. O. Waldman, Jr. Past-Chairman, was—with due ceremony—presented with a Past-Chairman Pin.

The regular business meeting was followed by a talk by L. W. Delhi, Vice-President of Western Pipe and Steel Co.,

Director-at-Large of the AMERICAN WELDING SOCIETY and charter member of the San Francisco Section. Mr. Delhi's word picture of his vision of the future of welding gave us an insight of probable things to come. His references to the effect of electronics in the field of welding excited the imagination and fomented an overpowering desire to translate words into action.

The technical talk was presented by the Vice-Chairman of the Section, Leo Berner, Welding Engineer, Joshua Hendy Iron Works. Mr. Berner's talk on Fundamental Welding Design Factors was very interesting and enlightening. All of those who attended the meeting were very favorably impressed with Mr. Berner's excellent presentation of those most important factors of design.

The meeting adjourned at 9:30 P.M.

After the meeting, the sound motion picture entitled, "Aircraft Welding," was shown. This film was obtained through the courtesy of the United States Navy. The equipment was supplied through the courtesy of the Victor Equipment Co.

## SOUTH TEXAS

Newly elected officers of the South Texas Section are as follows: *Chairman*, E. C. Jackson; *Vice-Chairman*, W. E. Klauberg; *Secretary-Treasurer*, A. E. Wisler; *Directors for One Year*, C. G. Alhart, S. F. McDonald, Ben Allen, Roy Brunt, E. C. Dupree, D. V. Witcher; *Directors for Two Years*, Harry Smith, G. C. Steffen, Walter Tofe, M. P. Hare, W. T. Hudson, L. H. Courtright. *Committee Chairmen: Program*, G. C. Steffen; *Entertainment*, Lloyd Daigle; *Membership*, F. E. Garriott; *Technical*, W. E. Klauberg.

A dinner meeting was held at Kaphan's, Houston, Tex., on October 6th. There were about 60 present. After the dinner a half dozen short war pictures were shown, which were very interesting. The speaker of the evening was W. S. Janssen, Assistant Chief Construction and Maintenance Engineer for Pan American Refinery Co., Texas City, Tex.

## SYRACUSE

The September meeting, held on the 14th at the Syracuse Museum of Fine Arts, was addressed by W. R. Grunow of the Allegheny Ludlum Steel Corp., whose subject was "The Welding of Stainless Steel."

The October meeting was held on the 12th. G. O. Hoglund of the Aluminum Co. of America was the guest speaker.

Mr. Hoglund showed the Aluminum Co.'s "How to Do It" movie on welding aluminum. This was followed by a very interesting discourse by Mr. Hoglund on some points in aluminum welding not brought out by the movie. Also, on display were some interesting examples of aluminum welding and brazing.

The meeting was attended by fifty-eight.

## TIDEWATER

The Tidewater Section of the AMERICAN WELDING SOCIETY, held its first meeting of the ensuing year 1944–45, Sept. 12, 1944, at 8:00 P.M., in the Fleet Reserve Hall, 305 High St., Portsmouth, Va.

The meeting was called to order by C. O. Barham, Section chairman. The By-Laws for this recently organized Tidewater Section, which had been drawn up by the Board of Directors, were read by the Secretary to be voted on for approval. The Section voted unanimously for the approval of the By-Laws as read.

Bill Couch, a representative, of Air Reduction Sales, in Savannah, Ga., was introduced to the Section, and expressed his appreciation for being able to attend the Sections first meeting, and of having the pleasure of introducing the speaker of the evening, his friend and colleague, La Motte Grover, Welding Engineer of the Applied Engineering Department, of Air Reduction Sales.

Mr. Grover was introduced and gave a most interesting lecture on the topic "Designing Ships for Welding and Speeding Up Ship Construction," accompanied by slide pictures, showing methods and illustrations.

After the lecture, the Meeting was opened for discussion, and many questions, concerning welding, cutting, ship designing and construction, and welding alloy metals, were asked and very efficiently answered.

Mr. Barham, expressed his gratitude on behalf of the Section to Mr. Grover for coming and rendering such a splendid lecture.

The Meeting was adjourned and light refreshments were served.

This was an open meeting, approximately 50 persons were present.

## TOLEDO

The September meeting of the Toledo Section was held at the Secor Hotel. The speaker was L. G. Pickhaver, Field Engineer of General Electric Co., and he gave a very interesting talk on "There Gaseous Shielded Arc-Welding Processes: Atomic-Hydrogen, Helium and Argon," which was very well received by a large audience of members and interested friends of the Section.

The round-table discussion following was brisk and very helpful.

## WESTERN MASSACHUSETTS

The Western Massachusetts Section held its first meeting of the 1944–45 season on September 27th at the Auditorium of the East Springfield Plant of the Westinghouse Electric and Manufacturing Co.

Dr. William G. T. Theisinger, Assistant to the Vice-President of the Lukens Steel Co. presented an excellent lecture on "The Manufacture and Use of Clad Steels." His presentation was accompanied by a color film and the technical portion by slides.

Following the lecture there was an interesting discussion during which Dr. Theisinger capably explained the technique of welding and joining clad steels.

## WESTERN MICHIGAN

The first meeting of the 1944–45 season of the Western Michigan Section was held on September 25th at the Rowe Hotel, Grand Rapids. L. G. Pickhaver spoke on "Three Gaseous Shielded Arc-Welding Processes: Atomic-Hydrogen, Helium and Argon." A film "Inside of A. C. Welding" was also shown. Both the address and the film were very well received by the 60 persons present.

It was announced that Carol Lanphear resigned as Chairman of the Section. New Chairman elected is W. J. Edbrooke of the Haven-Busch Co., Grand Rapids, Mich.

## WESTERN NEW YORK

The first meeting of this season was held Sept. 29, 1944, at the Forty and Eight Club, 891 Delaware Ave., Buffalo N. Y.

The speaker of the evening was Clinton E. Swift, Assistant Manager, Eutectic Welding Alloys Co., giving a talk on "Low Temperature Welding."

A lively discussion of the subject was held during the showing of the slides and also at the conclusion of the speech.

## YORK—CENTRAL PENNA.

Complete programs of coming meetings of this Section were given in the Section Activities in the September issue of THE WELDING JOURNAL.

The Section has inaugurated a Technical Advisory Service for the benefit of all industries or persons located within the Section's geographical boundaries. A committee composed of technical men, highly conversant with welding problems of every nature, will be the medium through which the service will be made available. Anyone desiring to use this service is requested to submit his problem to the chairman of the committee or to any of his associates. The answer will be returned to the inquirer at the earliest possible moment by mail. The question or problem and answer will be read at the next regular meeting of the Section. The sponsor's name will no tbe used unless permission is granted.

Exhibit Number One on "Stainless Steel Welding" by York Shipley Inc. was held in connection with the October 11th meeting. A sound movie, "Stainless Steel," showing the manufacture of stainless steel from electric furnace to the finished product, was shown.

"Welding of Stainless Steels" was presented by W. R. Grunow of the Alloy Sales Division of Allegheny Ludlum Steel Corp. A sound movie in color, "The Metallic Arc Welding of Chromium-Nickel Steels," was also shown.

The December meeting will be held on the 13th at the Engineering Building, 26 South Beaver St., York, Pa. E. B. Van Sant, Superintendent of The Badenhausen Corp., will speak on "Welding for High Pressures." A moving picture of modern boiler operations will be shown.

# Annual Report on Activities of the American Welding Society Year Ended September 30, 1944

## PRESIDENT'S ADDRESS TO THE MEMBERS OF THE AMERICAN WELDING SOCIETY

### Annual Meeting—1944

By D. Arnott

During modern war technological progress by necessity is greatly accelerated. Indeed, the Welding Committee of the Emergency Fleet Corporation was the background for the formation of the American Welding Society twenty-five years ago. There can be little doubt that in the war which we are fighting the welding industry has given the United States the greatest production tool of modern times for the construction of ships, tanks, planes and implements of war. The techniques used in welding today represent the continuous growth of a great industry. We like to believe that the American Welding Society did its share in developing the art and science of welding in the last generation and that today the Society through its manifold activities is playing an ever-important part.

With the great extension in modern welding techniques come problems which must and will be solved. Anyone who reads The Welding Journal regularly will get an idea of the tremendous amount of research which is being carried on in an effort to keep pace with the unprecedented development of the art. We must be careful to resolve the art and science of welding into certain fundamentals and not clutter up procedures with minutiae so that only a hierarchy of experts understands how to weld. We should not consider welding as a substitute for riveting without taking into consideration the necessity for changes in design and materials. Weldability is a characteristic which should be fully understood so that new alloy metals may be welded efficiently.

When this war is over we earnestly hope that the lessons in welding technique which we have learned during it will be put to the use of our American civilization and indeed that of the world. Our industrial development has been great, but sociological wounds of a most serious nature will have been inflicted on our civilization. We should do our best to see that the same energy, the same devotion to duty which characterized our conduct during the war, be used to inaugurate a thriving postwar industry.

We are glad that the Society has achieved new records in organization of Sections, in number of members, in amount of research, in increased revenue, in the amount of material published and in the development of new codes and standards. The Army Ordnance Distinguished Service Certificate which has been presented to our Society at this meeting is an indication of what help welding has been to the war effort.

These war years have shown the vital necessity that our permanent reserve fund be increased, and we are happy to report that this has been done. Our paid staff, who have served the Society so faithfully and efficiently, are now covered by an adequate pension plan.

To the new officers I give my best wishes, which are grounded in the assurance that the American Welding Society is on a sound basis and will continue to be one of America's leading engineering and technical organizations.

---

## ANNUAL REPORT ON ACTIVITIES OF THE AMERICAN WELDING SOCIETY

### Year Ended September 30, 1944

By M. M. Kelly, *Secretary*

After twenty-five years of carrying on our avowed purpose of advancing, promulgating and furthering the art and science of welding, our Society today ranks high among the leading engineering and technical societies.

Starting practically with no resources and some 200 members, the Society is now in a strong financial position and has close to 8000 members, distributed among 51 Sections, located in almost every large industrial and war production center in this country, with a goodly number in Hawaii, England, Australia, New Zealand, India, South Africa, Canada, Puerto Rico, Mexico and South America.

Our publications, particularly The Welding Journal and *Welding Handbook*, our technical and educational meetings, our standardization and research activities are known the world over.

The Army Ordnance Distinguished Service Certificate, presented to our Society at this meeting, is tangible evidence of the part the Society has played in the war effort. Honorable mention at an annual meeting of one of the high-ranking naval societies and the many complimentary letters received from members in allied countries on our various activities, are further evidence of the aid our Society has given in war production. A more complete account of these activities will appear under the appropriate headings.

*Meetings of the Board of Directors*

Three meetings of the Board of Directors have been held this past year, one in Chicago and two in New York. In addition, the Executive Committee held three meetings in New York. To save time and travel on the part of many busy executives, at the beginning of this year it was decided to hold three Board meetings, to reduce the Executive Committee personnel to a minimum, and to have it comprised of the President, First and Second Vice-Presidents, the Treasurer, the Outline of Work Committee Chairman and Vice-Chairman and the Welding Research Council Chairman and Vice-Chairman. As in the past, minutes of the Executive Committee meetings have been sent to the Directors and the time allowance for voicing objection to any action taken, was extended from one to two weeks.

Matters covered at the Directors' and Executive Committee meetings had to do primarily with the establishment of policies, By-Law amendments, new appointments, personnel changes and inauguration of new projects, all toward improving the operation of the Society, its Districts and Sections, to making them more useful to the membership and industry, and maintaining a friendly and cooperative relationship between them.

*Publications*

*Welding Journal*—THE WELDING JOURNAL, which continues to be one of the most important single activities of the Society, forms the major medium of contact between the entire membership and the working groups and officers of the Society. As an example, a paper presented before a local Section or national meeting reaches some 400 people, whereas the same paper published in THE WELDING JOURNAL reaches between 25,000 and 30,000 people. Through the Journal, every member has the opportunity of obtaining information contained in the best papers presented before the National Society and its Sections. The Journal also contains news items on activities of the Society, its Sections and committees, news of the industry, new products, new members, personal items and the like. Proposed standards and codes are usually published first in the Journal for comment. Industry also has the opportunity of publishing its new developments, new applications and engineering papers in general.

Through an arrangement with the Welding Research Council some eight years ago, a Research Supplement was added giving the entire membership of the Society the advantage of the research work carried out under the auspices of the Council and the affiliated companies and organizations. Through several channels the best research information in the welding field from abroad is also made available in the Supplement. The greater portion of the cost of publication is borne by the advertisers and, in turn, these advertisers have a medium for presenting their products to the purchasing power of the industry.

The Publication Committee and the Editor of the Journal have an unusually difficult task in meeting the requirements of a diversified membership representing as it does the operator, supervisor, foreman, inspector, instructor, draftsman, salesman, executive, engineer and scientist. Obviously, every article cannot appeal to all of these groups. The answer, of course, is a suitable balance, but there is a wide divergence of opinion as to where the emphasis should lie and the proportion of articles to be devoted to each group. Even on these simple points, opinions are sometimes academic as the Editor does not have a pool of articles which he can draw upon. A real task presents itself to maintain even a reasonable balance in some fields. To assist the Committee and Editor, the Society has resorted, from time to time, to obtaining the basic information as to the interests of members through the aid of a questionnaire and a new one is contemplated shortly.

Toward the end of the last fiscal year, the Publication Committee undertook a study as to the desirability of the Society publishing a supplemental journal of interest to the operator and supervisor. As a result of this study it was unanimously agreed that it would not be to the best interest of the Society financially and otherwise to undertake this task.

During 1943, the revenue of the Journal from subscription, advertising and other sources was the largest in the history of the Society.

For the first time the Year Book of the Society, although still coming under the jurisdiction of the Publication Committee, was divorced from the Journal and published separately. A comparison of the number of printed pages for the calendar year 1942, as compared with 1943, follows:

| | 1942 | 1943 |
|---|---|---|
| Journal | 886 | 1084 |
| Supplement | 620 | 640 |
| Total | 1506 | 1724 |

Government restrictions as to the use of paper has made it necessary to once again cut the weight of the paper but it is hoped that this will be the last.

*Welding Handbook*—Indicative of the tremendous demand for the *Welding Handbook* for reference purposes is that over 12,000 copies have been disposed of to date and a second printing of 5000 is under way. It is, however, the opinion of the Handbook Committee that a new edition should not be undertaken until the war is over for the reasons that (1) suitable editorial personnel is not available, (2) welding experts will not have the necessary time to devote to the preparation of text material and (3) welding data now regarded as confidential, will then be available for inclusion in the book, the latter being a very important consideration.

The fine cash balance in the Handbook account, after payment of outstanding bills and the setting aside of an appropriate amount to get a new edition under way, made possible the transfer of $10,000 of this fund to the Society's permanent fund.

*Educational Books*—The Special Committee on Recommended Procedure for Publishing Educational Manuscripts in Book Form, with scope to decide material to be published in book form, approve all expenditures for the work, set the sale price on the books and propose rules for compensation of authors of books, arranged during this past year for the publication of the following books: *Practical Design of Welded Steel Structures*, by H. M. Priest; *Measurements of Cooling Rates Associated with Arc Welding and Their Application to the Selection of Optimum Welding Conditions*, by W. F. Hess, L. L. Merrill, E. F. Nippes, Jr., and A. P. Bunk; *Guide to Weldability of Steels*, by a Committee; *Glossary of Foreign Welding Terms*, by M. Cordovi.

A sum of $5000 was made available to the Committee for operations during the fiscal year. As a result of study of the practices of other societies, the Committee recommended certain regulations in regard to compensation of authors, which have been approved by the Board of Directors. Although each of the books has been published primarily as a service to industry, nevertheless, in each instance, it is firmly believed profit will accrue to the Society over a period of years.

*Foreign Libraries*—Request from the Ukranian Academy of Science Library for replacement of its welding publications lost as a result of the war, resulted in the appointment of a Special Committee on Handling Requests of Foreign Libraries for Welding Publications. This Committee made the following recommendations to the Board of Directors which were approved: (1) That a definite plan of action be postponed until the probably postwar outlook is clear; (2) that for the time being special requests be handled separately, each on its merits; (3) that special requests for the *Welding Handbook*, up to 10 copies, be granted at the discretion of the Secretary; (4) that the Society's efforts on behalf of foreign libraries in the future be limited strictly to A.W.S. publications, and in preparation for postwar action, steps be taken now to promote voluntary return to Society Headquarters of back numbers of THE WELDING JOURNAL and Research Supplement by requests and explanation in THE WELDING JOURNAL, to be repeated at suitable intervals; (5) that the Special Committee be continued in office to deal with this problem until need no longer exists. Continuation of the Committee should be in the names of the following offices: Treasurer, A.W.S., Chairman, Publication Committee, A.W.S., Editor, THE WELDING JOURNAL.

Last December, the American Library Association became concerned with this problem and it seemed to the Committee that this organization could, through its own knowledge, act more discriminately toward foreign library requests than could the Society. The Committee suggested that ten sets of THE WELDING JOURNAL be furnished the American Library Association without charge, with the understanding that copies would be given free to foreign libraries and research institutions only when deemed worthy, and with the further understanding that the American Library Association will keep the A.W.S. informed of requests for THE WELDING JOURNAL coming to its attention, so as to avoid duplication in fulfillment of requests for free copies and subscription orders. These suggestions have met with the approval of our Board and the Library Association.

*Membership and Sections*

Again it is pleasing to report a very substantial gain in membership for the year. New members obtained represented a 38% increase against which there was a 21% loss, making the net gain approximately 17%. Gains and losses in the various classifications in terms of percentages are given below:

| | Increases | Decreases | Net Gain |
|---|---|---|---|
| Sustaining Members | 32 | 7 | 25 |
| Members | 48 | 11 | 37 |
| Associate Members | 44 | 17 | 27 |
| Operating Members | 8 | 49 | 41* |
| Student Members | 22 | 59 | 37* |

* Loss.

The Sections which bettered the average net gain of 17% for the Society as a whole include: Detroit, Lehigh Valley,

Los Angeles, Louisville, Mobile, Puget Sound and San Francisco.

During the year 8 new Sections have come into being, namely, Brunswick, Ga.; Pascagoula, Miss.; Pearl Harbor, Portland, Me.; Portland, Ore.; Syracuse, N. Y.; Tidewater, Va., and Western Michigan. Sections in South Bend, Ind., and Tampa, Fla., are in the throes of organization.

The organizers of these Sections, with the aid, in most instances, of the District Vice-Presidents and Membership Committee Chairman, have done an admirable job of laying the foundation for sound, healthy Sections. Largely to them belongs the credit for the considerable growth in Sustaining Members.

The rebuilding of the Pacific Fleet and the accomplishments of the Pearl Harbor Navy Yard are among the outstanding developments of the war. Welding played a very large part in this reconstruction and the value of the contributions of the AMERICAN WELDING SOCIETY was appreciated to the extent that a very active Section has been formed in Pearl Harbor.

Our pleasure at the substantial gain of most of the established Sections has been tempered somewhat by the loss, in a few of the Sections, which can be accounted for by the change in membership classification. We must report also a few inactive Sections, which is the result of industrial changes in the particular industrial districts in which they are located.

When victory is ours we may expect the mass interest in welding to lessen but your Membership Committee is of the firm conviction that with coordinated publicity and the continuance of good meetings, we shall continue to grow. The appreciation of welding as a science is spreading and as it spreads the AMERICAN WELDING SOCIETY should be the fountainhead of fundamental knowledge. We can expect our membership to reflect this fact.

While the Membership Committee has held no meetings, every member has made substantial contributions toward membership gain, and their helpfulness is appreciated. The Society is indebted to the Membership Committee Chairman, who has given unstintingly of his time in talking before the Sections and promoting welding generally.

The Society is indebted also to the Air Reduction Sales Co., Federal Machine and Welder Co., The Linde Air Products Co., P. R. Mallory & Co., Inc., and Metal & Thermit Corporation for the preparation of copy for membership ads which appeared monthly in the three welding publications, through the courtesy of *The Welding Engineer, Industry & Welding*, and THE WELDING JOURNAL. These ads have been instrumental in spreading the good news of the Welding Society and its possibilities.

The new attractive membership prospectus of which over 14,000 copies have been distributed during the year, with the assistance of the Sections and a number of Sustaining Company members, is responsible also for bringing in many new members.

Membership status as of September 1, 1944, is shown below:

| | A | B | C | D | E | F | Total |
|---|---|---|---|---|---|---|---|
| Total membership, September 1, 1943 | 101 | 2047 | 3225 | 1254 | 2 | 32 | 6661 |
| Gain (new members, increase in classifications & reinstatements) | 33 | 995 | 1437 | 107 | .. | 7 | 2579 |
| | 134 | 3042 | 4662 | 1361 | 2 | 39 | 9240 |
| Loss (resignations, cancellations because of delinquency and decreases in classification) | 7 | 230 | 554 | 621 | .. | 19 | 1431 |
| Total membership, September 1, 1944 | 127 | 2812 | 4108 | 740 | 2 | 20 | 7809 |
| Net changes during year | 26 | 765 | 883 | −514 | .. | −12 | 1148 |

The Sub-Section of the Detroit Section, formed in Flint, Mich., because distance was a barrier to full participation in Section affairs, has held well-attended meetings this past season. It is hoped ultimately this group will develop into a full Section.

At a meeting of the Section Advisory Committee, held during the year, it was deemed fitting, where a situation exists comparable to Flint, a group should be permitted to operate as a Sub-Section until the work gains momentum sufficient to warrant the organization of a Section.

The technical and educational programs of most of our Sections, this past year, have been of a high order. In addition to the regular technical meetings, the features of the year's work in aiding war production included panel discussions under WPB sponsorship, war films, cooperation in planning of engineering, science, management war training programs, lecture courses, information and answer sessions and the annual welding conferences. The social programs included a wide variety of entertainment, such as dinner dances, smokers and carefully planned gatherings of an outdoor nature.

Because of the great demands on the time of the President, he was unable to carry out his plans for visiting all of the Sections during the year. Nevertheless, his travels enabled him to address a number of Sections in the Middle West, West, Southwest, as well as some of the Eastern Sections. The Secretary visited four Sections and most of the other Sections were visited by their District Vice-Presidents. In many instances, the District Vice-Presidents have aided in the organization of new Sections in their Districts. They have also, through correspondence, kept the Section officers informed on matters affecting the Sections' membership and acted as liaisons between the parent organization and the Sections.

The Section Advisory Committee, now composed of the seven District Vice-Presidents, has during the past year given consideration to By-Law revisions covering in detail the duties of Section officers, term of office and the duties of the District Vice-Presidents; to the clarification of designation of Sustaining Member and Sustaining Companies; to the establishment of suitable Section boundaries; and to a proposed Student membership application form. Recommendations were made to the By-Laws Committee on the basis of comments received from the Sections and the resulting revisions on duties of Section officers and the term of office and duties of District Vice-Presidents were approved by the Board of Directors. Recommendations for the clarification of designations "Sustaining Members" and "Sustaining Companies" and the establishment of Section boundaries, made to the Board of Directors, are under advisement.

The sixth Annual National and Section Officers Conference, held in Chicago a year ago, was very well attended, representatives coming from all parts of the country. Endeavor was made to seat representatives of Sections in each District together in order to get them acquainted and to provide opportunity for an interchange of ideas. Following talks by the National Officers, the Sections were afforded time to express their views on Society affairs. Definite recommendations for improvement in Section, District and National Society operations were offered to the Board of Directors. Some of these have resulted in By-Law revisions, while others are being studied.

Suggestion that the standard letterhead of the Society be universally adopted by the Society Sections and committees has been transmitted to the Sections and committees with the hope that in time this suggestion will be followed.

### *Membership Application Forms*

The Special Committee on Membership Application Forms, having completed its task on the forms for Member and Associate Member grades, has this past year devoted its attention to forms for Sustaining and Student Members, has approved form for Student Membership and the form is now under consideration by the Board of Directors. Action on form for Sustaining Member is being held in abeyance awaiting decision on change in status of Sustaining Members and Sustaining Companies.

### *Admission to Membership*

Since the discontinuance of the Operating Membership, the work of this Committee has been considerably lightened.

One problem came up during the year concerning the wishes of welding operators to take out full membership in the AMERICAN WELDING SOCIETY. The Committee felt that one grade of membership might be advantageous, and that lack of professional qualification should not be used to prevent anyone from aspiring to whatever grade of membership he wished to hold. However, since this was very much a

policy matter in which the New York staff of the Society, with their frequent contacts with the Board of Directors, was best able to administer, it was suggested that the review of applicants be left to the New York staff rather than having this work done by the Committee on Admissions.

As a general policy, the Committee wishes to adopt a democratic attitude, allowing anyone who wishes to pay for a higher membership grade, the privilege of so doing. The only restrictions on this procedure might be those coming from a mass of applications from some undesirable group wishing to join the Society for other than the purposes for which the Society operates.

*Finances*

In accordance with past practice, complete statements covering the Society's financial operations for the year ended September 30, 1944, will be published in the Society Year Book. At this time, it is the pleasure of the Finance Committee to report that for the 11 months' period ending August 31, 1944, our actual operations showed a betterment over our budget of $25,105 and a net excess of income over expense in the amount of $27,981, allowing for the setting aside of 1% of the gross income to be transferred to the permanent reserve funds. This favorable excess of income over expense has enabled the Board of Directors to establish an adequate retirement plan for the Society's employees to which both the employees and the Society contribute. The plan now in effect represents many months of study on the part of your Finance Committee.

Three meetings of the Finance Committee have been held during the year. These have been largely devoted to the preparation of the budget, study of the financial operations and to the preparation of the retirement plan. In view of the possibility of adding an assistant to the Society's technical staff, consideration was given to additional office space. On recommendation of the Committee, the Board of Directors authorized taking an option on space adjoining Headquarters soon to be vacated.

The activities of the Special Committee appointed to build up the permanent reserve funds have been confined to solicitation of Sustaining Members and Sustaining Companies. A letter went out to 163 addresses. The initial response has not been as great as had been hoped but, nevertheless, has been encouraging. Subscriptions have been received from 51 companies to the total amount of $20,530. Those that have not replied will be resolicited. The names of the subscribing companies will be published in an early number of THE WELDING JOURNAL. On recommendation of the Welding Handbook Committee, $10,000 has been transferred to this account, thus making the monies collected to date $30,530. Of this amount, $10,000 has been invested in U. S. 2½% Treasury Bonds and a further investment of $10,000 has been authorized.

After consultation with bankers and investment brokers, last February the six St. Louis-San Francisco Railway Co. prior lien Series A 4% bonds due July 1, 1950, purchased by the Society in 1927, with 1/1/34 and subsequent coupons attached, were sold at 43½ flat, and, after payment of tax and commission, a total of $2592 was credited to the Society's permanent reserve fund.

During the past year, the Permanent Fund Committee invested $15,000 in 2½ U. S. Treasury Bonds due March 15, 1970-65, $5000 of this amount being withdrawn from the Permanent Reserve Fund and $10,000 from the Special Reserve Fund.

As it is the opinion of the Permanent Reserve Fund Committee, in which the Special Reserve Fund Committee concurs, that monies in these two funds beyond a month's operating expenses of the Society, estimated to be in the neighborhood of $10,000, ought to be invested, the Permanent Reserve Fund Committee has just authorized the purchase of a $10,000 2½ Treasury Bond. It is the plan to build up the Permanent Reserve Fund to $7500; to retain a $2500 minimum in the Special Reserve Fund and to invest monies over and above these amounts on authorization of the Permanent Reserve Fund Committee.

*Education*

Because of the entrance of undergraduates into the armed forces and the interruption in university scheduled engineering courses, the Educational Committee has not yet undertaken the preparation of prospectus to stimulate welding in engineering colleges and universities. The Committee is meeting during this Annual Meeting to lay plans to carry out this assignment during the coming year.

*By-Laws*

The By-Laws Committee of the A.W.S. has reviewed proposed By-Laws for the following Sections of the A.W.S.: Tidewater, Va., Brunswick, Ga., Western Massachusetts, Portland, Ore., Western Michigan, Indiana, Syracuse, New Jersey.

A revised "Draft of By-Laws Suggested for a Section" was prepared which incorporates therein the duties of the officers.

The By-Laws of the A.W.S. were revised in regard to the duties of District Vice-Presidents, and revising their terms of office to two years instead of one, with about half of their number being elected each year. The method of appointing the District Nominating Committee was also revised.

The By-Laws were also revised in regard to "Management"; the duties of the Board of Directors and of all the officers were revised to conform more closely to actual conditions.

The Section Advisory Committee membership was revised to consist of the District Vice-Presidents with one of their number appointed as Chairman.

*Meetings*

The 24th Annual Meeting, held in Chicago in 1943, was notable for the high calibre of its technical sessions which drew record attendance. The three and a half day Meeting was devoted exclusively to technical and educational sessions, standardization and research conferences and committee meetings. In all, 19 technical sessions were held at which over 60 papers were presented. Although our total registration figure was over 1500, this did not represent the complete A.W.S. attendance as many of those in attendance belonged to other societies participating in the National Metal Congress and registered with these other societies.

For the grand success of this Meeting, special praise is due the Convention Committee and our host Section, Chicago, who so ably handled all arrangements involved in the conduct of such meeting; to the Program Committee for the outstanding sessions staged; to the Publicity Committee for widely publicizing the meeting; and to the Society staff.

The Manufacturers Committee met during the 1943 Annual Meeting and submitted recommendations to help guide the Convention Committee in formulating plans for the Society's 1944 Convention. The Committee is again meeting during the 1944 Annual Meeting to study the situation in regard to the Society's participation in the 1945 National Metal Congress and Exposition.

On recommendation of the Manufacturers Committee, it was decided to hold the 25th Annual Meeting of the Society in Cleveland in conjunction with the 1944 National Metal Congress, if invitation was received to participate in this Congress. Pending receipt of this invitation, tentative arrangements were made by the Convention Committee for housing the A.W.S. Convention in the Cleveland Hotel. Upon receipt of invitation to participate in the Congress, under the same arrangements and financial terms as in previous years, the Convention Committee was authorized by the Board of Directors to proceed with arrangements for a 3½ day meeting, with no social functions.

Two meetings of the Convention Committee were held in Cleveland, the first to get local activities under way, to inspect the Hotel Cleveland space and facilities, and to consult with the Cleveland Convention Bureau on the proposed method of handling hotel room reservations for the National Metal Congress in the interest of A.W.S. On that evening the Convention Committee Chairman attended the Cleveland Section meeting and took occasion to arouse local enthusiasm. A second meeting was held the latter part of August to review activities to date and arrange for the necessary follow-up work. The morning preceding the Convention Committee meeting was devoted to a session with the Housing Committee when reservations of all participating societies received up to that date were inspected and approved by each of the participating societies' representatives for assignment of rooms in the various headquarters hotels, in so far as possible. It was agreed that every attempt would be made by the Housing Committee to place members and guests of the participating societies, that could not be accommodated in their

headquarters hotels, in hotels as near to headquarters as possible. It was believed that accommodations can be found for all wishing to attend the Congress. Despite the handicaps of the reduced time and the banned social activities resulting from the present war emergency, every effort was made to make this program particularly outstanding and attractive.

Although considerably handicapped by governmental restrictions on the release of material and limited time by competent engineers and scientists to write papers, the National Program Committee has, neverthlesss, worked diligently on arrangements for the Annual Meeting Program on the occasion of the 25th Anniversary of the Society. As a result of this activity and with the usual cooperation of the Welding Research Council, a program of unusual interest and importance has been provided.

The 25th anniversary is recognized in addresses by two outstanding nationally known authorities who will show the part played by welding and the Society in shipbuilding and war equipment. Another highlight is the Adams Lecture on "Solid Phase Welding." In addition to these special features there will be 56 technical papers prepared by some 80 outstanding authorities.

These papers and addresses will be divided among 18 sessions covering welding and cutting in heavy industries, railroad welding, weldability, resistance welding, structural applications, welding research, ship welding, aircraft welding, machinery, piping and pressure vessels, foundry and miscellaneous.

*Publicity*

The development of a program of publicity consistent with the needs of the Society and its standing as a technical organization has engaged the attention of the Publicity Committee this past year. The Executive Committee has approved a general program which is intended to extend knowledge of the name and work of the Society beyond its normal sphere of activity to industry generally and to create widespread acceptance of the Society as an important body and as an authoritative source of information concerning welding. The creation of such name prestige and widespread acceptance is expected to become a valuable asset in the important matters of maintaining or building membership, and, when desired, in obtaining support for, or cooperation in particular undertakings from other groups. In furtherance of these activities a budget item was approved providing for the employment, on a part-time basis, of a publicity representative who serves also as secretary to the Committee and will assist in handling publicity matters at the Annual Meeting. This employee is a member of the Society and an editor of a technical magazine dealing with the affairs of an industry in which welding is employed extensively. He maintains regular contact with Society headquarters. The Publicity Committee, before recommending this action, had studied the publicity activities of other technical societies and considered the possibility of utilizing the services of a reputable publicity and advertising agency. The cost of an adequate program handled through a commercial organization would have been greater than that required by the plan adopted. And, there was little assurance that, without time-consuming cooperation from interested committees and the Secretary's office, the agency would be able to prepare proper technical releases. The present arrangement does away with this objection and, in addition, keeps full control of all national publicity activities within the Society.

The Committee felt that the local Sections could contribute very greatly to furthering the interests of the Society by publicizing their activities with the areas in which they are located and has furnished them with a list of suggestions about ways in which they may be able to obtain local press cooperation. Some of the local Sections have been doing excellent work along this line for years while others have had less success; all have now been requested to direct some of their attention to extending public knowledge of their work and activities. The National Committee will extend its cooperation and advice when asked because it feels that the over-all effect of local Section publicity can be very valuable to the Society.

National publicity is being handled through the distribution to technical magazines and trade papers of information about Society publications, standards and research activities. The mailing list for such releases has been revised to provide selective coverage for matters limited in interest to specific industries or applications. In addition, selected newspapers having technical coverage and the various press associations receive Society releases.

Annual Meeting publicity is dealt with as a separate phase of the Committee's work and in conjunction with the Convention Committee. The budget approved has permitted the preparation and mailing of a program outline to about six hundred war contractors and sub-contractors in the Cleveland area directing attention to the importance of the papers being presented. The presentation of the Ordnance award was featured in this letter. Local Sections were also requested to obtain local newspaper attention for this award. A follow-up letter from the President to the same group again emphasized the value of the papers and the discussions following their presentation. Trade and technical papers, newspapers and press associations have been furnished with complete data concerning the program and with releases, including photographs, giving information about officers, award winners and the Adams Lecturer. Assistance has been given to publicity representatives from the Cleveland Section in preparing releases for the local press. Abstracts of papers have been prepared for distribution and help given to newspaper and magazine representatives in arranging interviews for articles and stories.

In all of its work the Committee has been in unanimous agreement in limiting publicity activities to what it considered would best serve the interests of the Society and contribute to the creation of prestige for it as a technical body.

*Awards*

The following selections have been made by the Awards Committee:

1943 Samuel Wyle Miller Memorial Medal
F. T. Llewellyn for conspicuous service in the Advancement of Structural Welding

1944 Lincoln Gold Medal
W. F. Hess and D. C. Herrschaft for their paper entitled "Spot Welding of S.A.E. 1020, 1035 and 1045 Steels in the 0.040-In. Thickness," published in October 1943 *Welding Journal Supplement.*

On recommendation of the Awards Committee, Dr. S. L. Hoyt, Battelle Memorial Institute, was unanimously approved by the Board of Directors as the 1945 Adams Lecturer.

The Judges of Award of the R.W.M.A. 1944 Prize Contest have selected as this year's winners the following:

Industrial Prize: R. B. Bland and P. E. Sandorff for their paper entitled "The Dynamic Properties of Flash-Welded Tubing," published in the June 1944 *Welding Journal Supplement.*

Honorable Mention:

L. C. Bibber and J. Heuschkel for their paper entitled "The Spot Weldability of Low Carbon and Other Aircraft Steels," published in the December 1943 *Supplement.*

B. Cooper for his paper entitled "Better Welds Through Regulated Welding Current," published in the January 1944 JOURNAL.

S. Wong and C. W. Steward for their paper entitled "Spot Weld Joint Efficiency," published in the April 1944 *Supplement.*

J. C. Barrett for his paper entitled "Properties of Heat-Treated Flash Welds in a Chromium Nickel-Molybdenum Steel," published in the May 1944 *Supplement.*

University Prize: W. F. Hess and D. C. Herrschaft for their paper entitled "Spot Welding of S.A.E. 1020, 1035 and 1045 Steels in the 0.040-In. Thickness," published in the October 1943 *Welding Journal Supplement.*

Honorable Mention: W. F. Hess, R. A. Wyant, O. E. Stabler and F. J. Winsor for their paper entitled "A Study of the Application of Refrigeration to the Cooling of Spot Welding Electrodes," published in the November 1943 *Supplement.*

*Public Relations*

As in the past, this Committee has been on the lookout for legislation of concern to the welding industry. Provisions of the Kilgore Bill, which provide for putting under control of government office or committee inventions, patents and dis-

coveries resulting from research; also scientists and technical personnel and scientific and technical facilities, has been under consideration. Inasmuch as the major engineering societies, in which A.W.S. members are well represented have representatives in Washington ready to oppose the Bill when it comes up for consideration, it was deemed unnecessary for our Society to take independent action. However, members of the Detroit Section went on record as favoring the recommendations of the Council Members of the Engineering Society of Detroit to oppose the Bill. The Bill is still in committee and it is doubtful that it will receive immediate consideration.

Quebec Assembly Bill No. 51 proposing a professionally endorsed system of licensing welding operators was brought to the Society's attention. After investigation, it was concluded that the Bill would constitute no serious hardship.

At the request of the Building Officials Conference of America, the Public Relations Committee considered ways and means of making agencies for certification of welding operators more readily available and less expensive. Since this subject is of concern to all regulatory bodies having to do with qualification of welding operators, the matter was referred by the Board of Directors to a Special Committee, with scope to lay plans for the calling of a conference of all interested groups for the purpose of considering the formation of a committee or organization that would investigate the subject thoroughly and determine what should be done in the direction indicated. The A.W.S. Special Committee prepared list of interested organizations and sent out call for the first conference. Mr. A. C. Weigel was named by the Board of Directors to represent A.W.S. at the proposed conference. The first conference was held in New York on August 25th when a permanent organization was effected.

### *Code of Principle of Conduct*

The Committee finds itself in the fortunate position of not having to function during the year.

### *Employment Service*

For the benefit of the Society membership and the welding industry, a column in THE WELDING JOURNAL is devoted each month to Positions Vacant and Services Available. We are able to include only those coming to the attention of Headquarters. We shall be glad to have more members take advantage of this service.

### *Acknowledgments*

The splendid results recorded above have been made possible only by the untiring efforts of the National, District and Section Officers, Committee Chairmen and Members, the loyal support of the Sustaining Members and Advertisers and to the devoted and effective work of the staff. To all, the Society is deeply indebted.

## WELDING RESEARCH

By C. A. ADAMS, *Chairman*, Welding Research Council, Engineering Foundation

Probably the greatest single accomplishment of the Welding Research Council during the past fiscal year is a better understanding of the fundamentals of two major problems which confront the welding industry, namely, Weldability and Weld Stresses.

We have already made substantial progress in the study of weldability, covering the base metal, the weld deposit, and the joint as a whole. Continuation and important additions are either under way or planned for the coming year. These have already been fully financed.

In our study of the very complex problem of Weld Stresses, the progress has been somewhat slower, although an excellent start has been made. From the rational standpoint this was literally a virgin field and we soon found a dearth of quantitative knowledge in the allied field of elasticity and plasticity. For example, it is one thing to know that a certain combination of multiaxial stresses exists in a certain region, but quite another to know how the metal behaves under those stresses, particularly the degree in which relief by plastic flow can take place, and the relation of this degree to the physical properties of the material in question.

Some twenty-five reports have come about as the result of the Welding Research Council's endeavors during the past year. These reports relate to a variety of subjects. In addition, many valuable reports have been contributed by cooperating agencies and member companies affiliated with the Council.

During the fiscal year ending September 30th, the Council published a total number of 680 pages in its regular *Research Supplement* as compared with 620 pages the year previous. In addition the AMERICAN WELDING SOCIETY has prepared several booklets and pamphlets of some of the special reports of the Council. Two University of Illinois Bulletins were issued during the fiscal year covering the Fatigue Investigations.

We are proud that some of the engineering societies and large technical trade associations have come to look upon Welding Research Council as their welding research organization. One large trade organization has contributed $62,000 for the current year. In this connection the members of Welding Research Council have had ample proof that its affiliation with Engineering Foundation is a very vital asset.

The Welding Research Council is particularly grateful to the AMERICAN WELDING SOCIETY for providing a forum for the presentation of its research reports at the Annual Meeting of the Society, and for the dissemination of knowledge gained in the *Research Supplement* of THE WELDING JOURNAL. The use of the results in the codes and standards of the Society is a decided inspiration to the research workers.

## TECHNICAL COMMITTEE ACTIVITIES

By R. W. CLARK, *Chairman*, Committee on Outline of Work

### Introduction

The Committee on Outline of Work has continued to direct the efforts of the Society's Technical Committees toward the fullest possible achievement in matters which would be of aid in our country's war effort. Other matters, of a more permanent nature, were also considered; these, however, were given secondary consideration.

In keeping with the desire to aid in the war effort, assistance, when required, has been rendered both to government agencies and private organizations engaged in such work. How successful the fulfillment of the desire to aid in the war effort has been, can be determined by the accomplishments of the past year as indicated in the progress report which follows.

### Administration of Technical Committee Activities

Acting on the recommendation of the Committee on Outline of Work, the Board of Directors voted in September 1943 to appoint Mr. S. A. Greenberg as Acting Technical Secretary of the Society for the duration.

On February 29, 1944, the Committee on Outline of Work, appointed a Subcommittee on Organization to study the present organization of Technical Committees and several alternate organizational plans submitted, and to recommend any changes which might be necessary. Undertaking its assignment, the Subcommittee on Organization prepared organizational charts showing the functioning of the technical committees under the present and proposed plans. Full consideration was given to each of the organizational setups and the Subcommittee unanimously agreed that whatever the setup, the motivating philosophy should be that the setup was flexible enough to permit the fulfillment of a particular assignment by a Technical Committee without too much encumbrance in functional details. It was finally determined that the present organizational setup was most satisfactory and presented none of the objections of the alternate proposals. The Subcommittee recommended, therefore, that no change be made in the present organizational setup of the Society's Technical Committees, and the Committee on Outline of Work accepted this recommendation.

In an attempt to improve the functioning of the Committee on Outline of Work, consideration was given to the organization of an Advisory Subcommittee composed of a few members which would serve to review matters concerning the technical committees of the Society as they might arise in the time between meetings of the Committee on Outline of Work, and recommend to the Committee on Outline of Work any specific actions which might be

necessary. A temporary Advisory Subcommittee was appointed for a trial period of one year and it is expected that this arrangement will now be made permanent.

### New Committee Activities

Two new technical committees were organized during the past year:

A Coordinating Committee on Research was appointed to effect a closer correlation between the AMERICAN WELDING SOCIETY'S standardization activities and the research activities of Welding Research Council.

A Committee on Metallizing was appointed to prepare standards for the various applications of the metallizing process.

Several new activities are being studied to determine the advisability of creating technical committees on brazing and on the application of welding in the railroad and automotive industries.

*Cooperation with Other Societies*

Two representatives on committees of other societies were also appointed during the past year as follows:

Mr. R. E. Cecil was appointed to represent the Society on the Advisory Committee of the National Board of Boiler and Pressure Vessel Inspectors.

Mr. D. H. Corey was appointed to represent the Society on the Editorial Committee of the Heating, Piping and Air Conditioning Contractors National Association

### Codes, Standards and Reports

*Codes and Standards*

The following standards were approved and published during the past year:

Part B-1, Oxy-Acetylene Welding of Steel-Aircraft of the Code of Minimum Requirements for Instruction of Welding Operators.

Weldability Standards for Alternate Aircraft Steels.

Structural Failures in Welded Ship Construction.

The following standard was revised and approved for publication:

Rules for Fusion Welding Piping in Marine Construction.

An Emergency Standard titled "Ordnance Inspection Handbook for Metal Arc Welding" was prepared by the A.W.S. Army Ordnance Advisory Committee and submitted to the U. S. Army Ordnance Department for publication and distribution among its personnel. It is also expected when the U. S. Army Ordnance Department completes publication of its edition that the Society will undertake publication of a similar edition for distribution to industry.

The following standards have been prepared and published in THE WELDING JOURNAL for comments but have not yet been approved:

Recommended Practices for the Spot and Seam Welding of Low Carbon Steels.

Recommended Practices for the Spot and Seam Welding of Coated Steels.

Recommended Practices for the Spot and Seam Welding of Stainless Steels.

Recommended Practices for the Flash Welding of Low and Medium Forging Strength Steels.

*Reports*

To meet the interest evoked by the deep-fillet welding process, a Special Committee to Obtain Data on Deep Fillet Welding was appointed by the Committee on Outline of Work to correlate the data available on the subject. A report on Deep Fillet Welding containing recommendations on the various aspects of the technique was prepared by the Special Committee. These recommendations have been transmitted to the existing A.W.S. Technical Committees and are being considered by them.

To meet the needs for a suitable standard on safety recommendations, the Society acting jointly with N.E.M.A. and R.W.M.A. recommended to the American Standards Association the preparation of an American Standard on the subject. A draft of the proposed safety standard was prepared by the A.W.S. Committee on Safety Recommendations and forwarded to an A.S.A. Committee which, after reviewing and revising the draft, issued a "Safety Standard in Electric and Gas Welding and Cutting," now published.

### Conclusion

Detailed considerations of the foregoing standards together with a report of the work now in progress, will be found in the reports of the individual technical committees.

The Committee on Outline of Work sincerely believes that the accomplishments indicated in the foregoing report are in keeping with its dedication to a full service in the war effort of our country, and, further, that these accomplishments represent a year of progress in the matter of permanent standards as well. The Committee is gratified too by the status of progress of standards now in the course of preparation and looks forward to even greater achievements during the forthcoming year. Acknowledgment is made to all those individuals whose efforts have contributed to this progress.

It is resolved that the Committee on Outline of Work, and through it all of the technical committees of the Society, will dedicate their efforts toward continued service to the technical needs of our country's industries in keeping with the AMERICAN WELDING SOCIETY'S position as the authoritative organization on welding.

*A.W.S. Army Ordnance Advisory Committee*

The A.W.S. Army Ordnance Advisory Committee was appointed on October 21, 1943, to assist on specially assigned welding projects as requested by the Army Ordnance Welding Committee.

The first task assigned to the Committee was the preparation of a manual setting forth that information which would assist the Ordnance Department inspector in more efficiently and expeditiously fulfilling his duties.

The completed draft titled, "Ordnance Inspection Handbook for Manual Metal-Arc Welding," includes sections on the qualifications of an inspector; the duties of an inspector; the philosophy and use of welding procedure and operator qualification tests; a discussion on welding defects and some possible causes; the standard methods of inspection and testing including their application and limitations; and a discussion on the use of welding symbols and standard welding nomenclature.

After final editorial revision, the "Ordnance Inspection Handbook" was approved as an Emergency Standard and submitted in June 1944 to the U. S. Army Ordnance Dept. for publication and distribution to Ordnance Department personnel. At the same time it was felt desirable to make copies of the Handbook available to industry, and it was therefore decided that the Society will publish a duplicate edition for that purpose.

Having completed this task, it is expected that the Committee will undertake the preparation of similar data on gas and resistance welding should the U. S. Army Ordnance Welding Committee deem this necessary.

*Conference Committee on Welded Bridges*

This Committee has been functioning since 1934 in the preparation of appropriate specifications covering the design and fabrication of welded bridges. The first edition of a specification was issued in 1936 and revised editions have been prepared periodically, the most recent in 1941.

Toward the end of the last fiscal year in 1943, the Committee reviewed and modified its personnel and organization preparatory to undertaking further revision of the *Specifications for Welded Highway and Railway Bridges.*

The various Subcommittees have now met and considered the respective sections of the Specifications assigned to them and it is expected that their tasks will be completed during the forthcoming year. The Committee will then review the revision and submit it for approval.

The new revision will include a modification of present design stress requirements, and the addition and clarification of weld detail requirements. It is therefore expected to be of significant assistance in postwar bridge construction.

*Committee on Building Codes*

This Committee has devoted its efforts to the preparation of suitable building code requirements for the control of welding in building construction. The most recent issue of such requirements titled, "Code for Arc and Gas Welding in Building Construction," was published in 1941 and is intended for adoption by municipal and other code-writing bodies.

Since the issuance of the Code in 1941 the Committee has applied its efforts toward a wider acceptance of the Code which would result in a uniformity of welding requirements in building construction. This past year the Chairman of the Committee has accepted two invitations of the Building Officials' Conference of America to present papers on welding requirements in building codes. Discussions following each of these papers indicated a lively interest among code enforcement officials in the subject of welding in building construction and served to

emphasize the importance of an AMERICAN WELDING SOCIETY standard in this field.

Numerous comments and suggestions have been submitted with respect to the present edition, which has a tentative status, and they have recently been sent to the members of the Committee for their consideration. It is hoped that a meeting can be arranged at an early date for the disposition of these, and any other comments which may be received, prior to recommending advancement of the Code to the status of a full standard.

*Committee on Definitions and Chart*

The present Committee on Definitions and Chart was appointed in 1938 and assigned the task of revising and bringing up to date the welding definitions prepared by an earlier Committee and issued in 1929. The Committee completed its initial work in 1939 and its report was published in January 1940 under the title of "Tentative Definitions of Welding Terms and Master Chart of Welding Processes."

In 1942 the Committee completed a revision of the tentative report which was approved and published as a full standard in 1942. The Society's standard definitions have been adopted in whole or in part by a number of other organizations including the American Institute of Electrical Engineers, the American Standards Association, the American Petroleum Institute and the Resistance Welder Manufacturers' Association.

During the past year the Committee has considered a revision of the present Standard to include new terms suggested by various groups. The Committee expects to present a revised report during the coming year.

*A.W.S-A.S.M.E. Conference Committee*

Active cooperation with the A.S.M.E. Boiler Code Committee has continued and a number of questions requiring consideration and study have been handled to mutual advantage. Welding operator qualification problems have continued to occupy the Committee's attention and our Committee has been able to render the Boiler Code Committee valuable assistance. The Conference Committee has been fortunate in having behind it the resources of the Society's files which have assisted the Boiler Code Committee on numerous occasions. The members of the Conference Committee are, of course, in close contact with the A.W.S. activities and they are thus able to keep the Boiler Code Committee in close touch with the developments in this field. The personnel of the Conference Committee is well suited to the purpose of this cooperative relationship and there appears to be no need for any change therein.

*A.W.S.-A.S.T.M. Committee on Filler Metal*

The A.W.S.-A.S.T.M. Committee on Filler Metal was organized in 1942. During the past year, the Tentative Specifications for Aluminum and Aluminum Alloy Metal Arc-Welding Electrodes, Serial Designation B184–43T was prepared and published, and the Tentative Specifications for Iron and Steel Arc-Welding Electrodes, Serial Designation A233–42T were revised and published as Serial Designation A233–43T, continuing as tentative. The Tentative Specifications for Iron and Steel Gas-Welding Rods, Serial Designation A251–42T were also continued as tentative.

The progress made is further indicated in the subcommittee reports which follow:

*Subcommittee I—Iron and Steel Arc-Welding Electrodes*

This subcommittee is now considering further revisions of the present Tentative Specifications for Iron and Steel Arc-Welding Electrodes, Serial Designation A253–43T, and it is expected that the revised specification will be submitted for approval later this year.

*Subcommittee II—Iron and Steel Gas-Welding Rods*

This subcommittee has recently reviewed the present Tentative Specifications for Iron and Steel Gas-Welding Rods and has decided to consider several suggestions which have been received for amplifying the specifications.

*Subcommittee III—Aluminum and Aluminum Alloy Filler Metal*

This subcommittee having recently completed specifications for aluminum and aluminum alloy arc-welding electrodes, has now undertaken the preparation of specifications for aluminum and aluminum alloy gas-welding rods, a first draft having been circulated to the membership for comments.

*Subcommittee IV—High Alloy Steel Filler Metal*

This subcommittee has been studying a proposed draft of specifications for stainless steel electrodes which has now been circulated for letter ballot approval of the subcommittee.

*Subcommittee V—Nickel and Nickel Alloy Filler Metal*

During the past year a tentative draft covering filler metal of Nickel, Monel, Inconel, Illium and the several Hastelloy compositions was prepared and discussed with the manufacturers of these compositions. Sufficient data were not available for Illium and the Hastelloys and it appears that the initial specification will have to be confined to the other materials mentioned.

*Subcommittee VI—Copper and Copper Alloy Filler metal*

This subcommittee is in its first year of operation and is engaged in the preparation of specifications for copper and copper alloy electrodes, which it is expected will be available in the near future.

In June 1944 it was also decided to organize a Subcommittee VII on Hard Facing Materials, but its organization is still in progress.

*Committee on Recommended Practices for Inspection of Welding*

This Committee prepared a report on Inspection which appears as Chapter 30 of the 1942 *Welding Handbook*. The report has also been published in pamphlet form under the title "Recommended Practices for Inspection of Fusion Welding."

While the Committee is an inactive one at present it was deemed expedient to continue it for the purpose of having it available in case there arose a need for changes in or additions to the Chapter which the Committee prepared for the 1942 *Welding Handbook*.

*Committee on Welding in Marine Construction*

This Committee has concerned itself with the standardization of welding practices in the shipbuilding industry. Its efforts have been devoted to the issuance of standards and reports on welding in shipbuilding, and, in accordance with recently adopted objectives, "to promulgating the maximum use in the marine field of the general codes and standards of the Society."

A meeting of the Committee was held in October 1943 during the Annual Meeting of the Society at which time its two subcommittees were reorganized and retitled "Subcommittee on Hull Construction" and "Subcommittee on Machinery Construction."

Each of these subcommittees has completed a report during the past year: The Subcommittee on Hull Construction completed the report, "Structural Failures in Ship Construction." The Subcommittee on Machinery Construction completed the standard, "Rules for Fusion Welding Piping in Marine Construction."

A meeting of the Committee has been scheduled during the forthcoming Annual Meeting of the Society at which time consideration will be given to preparing a program of work for the ensuing year.

*Committee on Minimum Requirements for Instruction of Welding Operators in Trade Schools*

This Committee is engaged in the preparation of proper minimum requirements for instruction of welding operators in trade schools. The Committee is concerned both with arc- and gas-welding and in formulating its standards has combined sound educational principles with accepted industrial practices.

In July 1942, the Committee completed the first of four basic courses of the Code of Minimum Requirements for Instruction of Welding Operators, titled "Part A—Arc Welding of Steel $^{3}/_{32}$ to $^{3}/_{4}$ In. Thick." This standard has met with wide acceptance, and the Committee has been very gratified with the assistance which Part A has been in the training of welding operators for war industry.

Having completed Part A, the Committee then elected to consider the preparation of a course in the oxy-acetylene weld-

ing of light materials. To meet the immediate needs of the aircraft industry it was decided to confine the course to aircraft welding. This course has occupied the greater attentions of the Committee during the past year. Two meetings were held the first in October 1943. Part B-1, "Oxyacetylene Welding of Steel-Aircraft" would have been completed at that time except that it was desired to have the Code conform to qualification test requirements of the Army and Navy (AN-T-38), and these were in the course of being revised at that time. It was decided at that time to defer final approval of Part B-1 until the qualification specifications were reissued.

The delay necessitated by this decision can be easily justified, however. The Army and Navy Working Committee, which was drafting the specification, was invited to consult with the Committee and through mutual cooperation both AN-T-38 and Part B-1 were improved and made to conform with each other.

At the second meeting of the Committee this year, Part B-1 was approved as revised and plans for the future work of the Committee were discussed. It has been decided that two new courses are to be prepared concurrently. They are:

(1) Arc Welding of Steel—Aircraft
(2) Arc Welding of Light Gage Steel

At the same time, Part A is to be reviewed and revised prior to recommending its advancement to the status of a full standard of the Society.

Among future courses to be prepared by the Committee are the Oxy-acetylene Welding of Steel (other than aircraft) and the Arc and Gas Welding of Piping.

How well the Committee's efforts have been received can be illustrated by the laudatory remarks recently made by Mr. L. S. Hawkins, Director of Vocational Training for Defense Workers, U. S. Office of Education. In expressing strong approval of the work of the Committee he stated that it served to demonstrate the soundness of industry and educators working together in planning training programs for the trades, combining up-to-date data of the industry and sound teaching methods. It would be most desirable, he further stated, if other industries recognized the leadership taken by the welding industry through the AMERICAN WELDING SOCIETY, and cooperated in the organization of similar committees in their respective trades.

*Committee on Non-Destructive Tests for Weld*

This Committee was organized January 1940 and is presently functioning through the following three subcommittees: Subcommittee on Visual Inspection, Subcommittee on Magnetic Particle Analysis, Subcommittee on Radiography.

During the past year one meeting of the Committee was held when it was decided to record the preference of the Committee for the A.S.M.E.-A.P.I. penetrameter in favor of other types suggested. At that meeting plans were also discussed for the Committee's activities in the preparation of an inspection handbook for the U. S. Army Ordnance Department. This work was later undertaken and sections of the handbook dealing with visual inspection, non-destructive test methods, magnetic particle inspection and radiographic inspection were prepared by members of the respective subcommittees under the direction of the Chairman of the Committee. These various efforts represent months of work, and are regarded as worthy contributions from the Non-Destructive Test Committee.

*Committee on Large Welded Pipe for Hydraulic Purposes*

The Committee, for the past two or three years, has suspended its activities due to war conditions. In 1941 the Committee was just about ready to propose a tentative code in this particular field of welding technique. The war, however, has absorbed the time and energy of the members to a point prohibiting their activity.

It may also be pointed out that at the present time there is little activity in the special field which would be covered by the code as proposed, and furthermore the very considerable amount of research and development work in the field of welding incident to our war effort may very well call for a review with reference to its possible influence on the proposed code.

For these reasons it has seemed entirely justifiable to defer any attempt to further work on the code until postwar conditions permit a survey of the results of this recent research and experimental work.

*Committee on Pressure Piping*

This Committee was appointed to prepare a Code for welding pressure piping for all applications, including hydraulic, gas, air, oil and refrigeration. The membership of this Committee is identical with that of the A.S.A. Sectional Committee on Code for Pressure Piping, Subcommittee No. 8, Subgroup No. 4, which Committee has reported to the Main A.S.A. Sectional Committee on Code for Pressure Piping. A Code has now been published. The Committee has undertaken no new work during the past year nor does it contemplate undertaking any new work during the coming year since it is believed that the A.S.A. Code fully covers the matter of pressure piping.

*A.W.S. Resistance Welding Committee*

The function of this Committee is to coordinate and present to industry, in the form of recommended practices and standards, information in the field of resistance welding which has been obtained directly from industry or from fundamental research projects.

A meeting was held in Washington on Dec. 16, 1943, for the purpose of coordinating the weld pull strength values for carbon and stainless steel with the Army and Navy services. As a result of this meeting standards of weld strength subsequently issued for Army-Navy specifications will be in conformity with A.W.S. recommended practices.

On March 10, 1944, Col. G. F. Jenks resigned as chairman of the Resistance Welding Standards Committee and J. R. Fetcher was elected to fill the vacancy. At the second of two meetings of the executive subcommittee, consideration was given to the need for reorganizing the personnel of the Committee. With the approval of the Committee on Outline of Work, the membership, which had previously numbered about 80, was reduced to about 35, and the Committee was retitled "Resistance Welding Committee." This Committee, as now constituted, largely parallels the membership of the Welding Research Council Resistance Welding Committee. It is felt that this parallelism will effect a coordination between the research developments and standardization efforts.

The work accomplished during the year is briefly as follows:

*Spot and Seam Welding of Low-Carbon Steel, Coated and Uncoated*

Recommended practices originally published in June 1943 have been revised with the addition of data on pulsation welding and information on the welding of coated steels. These data have been published for comments in the August 1944 issue of THE WELDING JOURNAL.

*Spot and Seam Welding of Stainless Steel*

As in the case of low-carbon steel data, the recommended practices have been published for comment in the August 1944 issue of THE WELDING JOURNAL.

*Flash Welding*

Recommended practices for flash welding of carbon and low-alloy steel have been published in the September 1944 issue of THE WELDING JOURNAL.

*Methods of Testing Resistance Welds*

Recommended practices have been compiled and will be submitted for approval and published shortly.

*Projection Welding*

The prominent fabricators using this welding process have been solicited for data on projection welding and the information so gathered is in the process of being compiled and published.

*Definitions and Symbols*

The subcommittee is now working on the revisions and additions to be made for both resistance welding definitions and symbols. It is hoped that this work will result in the clarifying of terms and their definitions which heretofore have been loosely used. Similarly, consideration will be given to the present use of resistance welding symbols and the need for change. When completed, this work will be coordinated with the definitions and symbols published by the A.W.S. Committees on Definitions and Symbols.

A subcommittee has only recently been

organized for the purpose of preparing recommended practices for the spot welding of hardenable steels.

A subcommittee was also organized for the purpose of studying electrode standards. This study was made in conjunction with the American Standards Association War Standards Committee on Resistance Welding, and the report of the subcommittee has therefore been submitted to the American Standards Association. Included in the report is a recommendation of a standard electrode taper which is the result of study made by this subcommittee.

The Resistance Welding Committee will continue to devote its work to the study of recommended practices and standards. There are two outstanding projects which it is felt should be considered. The first is the study of quality control by statistical analysis. Recent interest has been expressed by the aircraft companies in methods of quality control that are more reliable than those used heretofore. As yet, industry has not been supplied with data on the fatigue strength of spot and seam welds. It is hoped that research programs will be initiated in this vital field.

*Committee on Safety Recommendations*

During the past year several inquiries were presented to this Committee which were handled largely by correspondence. Information regarding the toxicity of welding fumes from electrodes, the dermatological effects of arc welding, the precautions to be taken in lead burning operations, and the proper precautions for protecting the eyes of welding personnel was provided in reply to these inquiries.

Early in 1943 this Committee commenced the task of drafting safety standards for welding and cutting and having completed this task later that year, submitted its recommendations to the American Standards Association. These efforts have resulted in the issuance of the A.S.A. War Standard, "Safety in Electric and Gas Welding and Cutting."

*Committee on Standard Tests for Welds*

The Standard Methods for Mechanical Testing of Welds prepared by this Committee were transferred from tentative to standard status somewhat over a year ago, and as a result during the past year this Committee was less active than during the preceding year.

A meeting was held in October 1943 at which the proposed Tee-Bend Test methods were carefully considered, and referred to a subcommittee for further study and revision. Final action on any proposed A.W.S. Weld Bead Hardness or Jominy Test standard methods was deferred. Consideration was also given to deviations between the A.W.S. tension-test specimen and a somewhat similar specimen called for in Army-Navy Specification AN-T-38, with a view to harmonizing the two.

In January 1944 a question was laid before the chairman of the Committee as to the specific elongation requirements to be specified for high tensile strength steels. This was referred back to the Committee on Outline of Work, as being outside the scope of this Committee, which deals particularly with methods of testing rather than specific values.

In view of the development of new methods of tests for resistance welds, additional members have been appointed to the Committee who would adequately represent this field.

*Committee on Standard Qualification Procedure*

The Committee on Standard Qualification Procedure is concerned with the formulation of standard methods for the qualification of welding procedures and welding operators, and the promulgation of these standard methods for adoption by code-writing bodies to effect a general uniformity of welding qualification requirements.

A standard qualification procedure, covering both welding procedures and operators, was prepared by the Committee and revisions to the original standard were made in 1938 and 1941, the latter being the issue in current use.

More recently it was deemed desirable to revise the present (1941) edition before advancing it from its tentative status to the status of a full standard of the Society. In this connection a meeting of the Committee was held in October 1943 during the Annual Meeting of the Society in Chicago. The proposed revision was discussed, and it was decided to divide the present Standard Qualification Procedure into separate standards for arc and gas welding, each of these being further subdivided into individual sections for procedure qualification and operator qualification. The drafting of these revisions is now in progress.

Another meeting of the Committee is to be held shortly at which time the Committee's present assignment will be further considered.

*Committee on Standard Procedures of Welding and Standards for Welded Joints*

This Committee was appointed for the purpose of preparing welding procedures and joint details for arc- and gas-welding low-carbon and commercial low-alloy steels. In an effort to simplify the work of the Committee, and thereby expedite its progress, it was decided to prepare an arc-welding procedure specification before starting work on a similar standard for gas welding.

A first draft of the tentative arc-welding procedure was prepared in March 1943 and distributed among all A.W.S. Technical Committee members who might be concerned with such a standard. On the basis of comments received and discussed by the Committee, a revised draft of the specification was prepared.

Two meetings of the Committee have been held this year to discuss the second draft, and based on the changes determined at these meetings, a third draft of the arc-welding procedure specification is to be prepared. It is hoped that this draft will be approved by the Committee after final modifications have been made.

*Committee on Rules for Field Welding of Storage Tanks*

This Committee has been assigned the task of developing general welding standards applicable to the construction of field welded storage tanks, operating generally at atmospheric pressure or at not over 15 lb. per square inch gage pressure. A specification entitled "Rules for Field Welding of Steel Storage Tanks" was published in December 1940. In 1941 a few minor revisions were made for purposes of clarification; these were published as amendments in May 1942.

The following conference committees of the main committee exist:

The A.P.I.-A.W.S. Conference Committee on Welded Oil Storage Tanks actively advise the American Petroleum Institute Committee on Oil Storage Tanks regarding all matters relating to welding.

The A.W.W.A.-A.W.S. Committee on Elevated Steel Water Tanks, Standpipes and Reservoirs prepared a specification for the American Water Works Association with the title "Elevated Steel Water Tanks, Standpipes and Reservoirs."

The A.R.E.A.-A.W.S. Conference Committee on Welded Storage Tanks for Railway Service served in the preparation of a specification covering "Welded Storage Tanks for Railway Service" which was issued in 1943.

The main committee and conference committees are prepared to review any matters presented to them by any of the coordinating societies in regard to specifications for the field welding of storage tanks.

*Committee on Symbols*

Due to the more or less informal agreement among the various members of the Symbols Committee that it would be undesirable to make any changes in the symbols during the present emergency, no changes have been made. A number of suggestions have been received from various agencies and a meeting is to be called at the Convention this fall in Cleveland, at which time these changes will be given consideration.

*A.W.W.A.-A.W.S. Committee on Specifications for Field Welding of Steel Water Pipe Joints*

This Committee has been engaged in the preparation of Specifications for the Field Welding of Water Pipe Joints. The Committee has been actively engaged in this effort and is presently considering a sixth draft of these standards. It is hoped that continued progress will permit the Committee to complete these standards in the near future.

**Reports of A.W.S. Representatives on Technical Committees of Other Societies**

*American Standards Association*

*Committee A-10—Safety Code for Construction Work*

This Committee has been very active during the past year. The complete Code was the subject of discussion at several meetings. A final draft was approved early this year and copies are expected to be available soon.

*Committee A-57—Building Code Requirements for Iron and Steel*

A.S.A. Sectional Committee A57 is one of a number of related committees appointed by the American Standards Association to study and recommend for adoption various building code requirements.

On June 11, 1943, the American Standards Association approved "Structural Steel (Riveted, Bolted or Welded Construction) A57.1-1943" prepared by this Committee.

No meetings have been held by the Committee during the past year.

It is recommended that the AMERICAN WELDING SOCIETY continue its representation on the Committee.

*Committee B-31—Code for Pressure Piping*

Sectional Committee B-31—Code for Pressure Piping held no meetings during the year. The last revision of the A.S.A. Code for Pressure Piping was completed in 1942. The revised Code was approved in November 1942 and subsequently published. No meetings of the Committee are contemplated until further revisions are required. However, in view of the welding industry's interest in the Code, the Society should maintain representation on the Committee.

*Committee C-42—Electrical Definitions*

An A.S.A. Standard covering Electrical Definitions was published in 1942. This Sectional Committee is to continue and will be responsible for preparing a revised edition for publication. It is recommended that the AMERICAN WELDING SOCIETY continue its representation on this Committee.

*Committee C-67—Preferred Voltages, 100 Volts and Under*

A meeting of this Committee was held on November 4, 1943. Such matters as standard voltage or preferred voltage were discussed and it was decided that definitions of all of the new terms used should appear in the American Standard on Definitions for Electrical Terms. The Committee authorized submitting the entire recommendations to the Committee membership. Ballot included vote on both the standard proper and the appendix.

*Committee Z-2—Protection of Heads, Eyes, etc., of Industrial Workers*

This Committee has not been called together during the past year and it is felt that there is no need for action at the present time.

*Committee Z-10—Letter Symbols and Abbreviations for Science and Engineering*

No meeting of this Committee has been held during the last year. Subcommittee 11 on Abbreviations for Scientific and Engineering Terms, on which the Society's representatives also serve, has likewise been inactive.

It is recommended that representation of the Society in this activity be continued.

*Committee Z-28—Work in Compressed Air*

No meetings of this Committee were held during the past year. A tentative code is being drafted to be submitted to the Committee for action before long.

*Committee Z-32—Graphical Symbols and Abbreviations for Use on Drawings*

There was no activity of this Committee so far as welding symbols were concerned.

*American Society for Testing Materials*

*Committee B-5—Copper and Copper Alloys*

There has been no meeting of this Committee during the past year. The purpose of this Committee is to draw up specifications relative to wrought copper and copper alloys, and it is desirable that a member of the AMERICAN WELDING SOCIETY be an active member of this Committee.

*American Institute of Electrical Engineers*

*Committee on Electric Welding—Subcommittee on Power Supply for Welding Operations*

This Committee has not met during the year. Although this Committee was very active a few years ago, the work completed at that time seems to have made it unnecessary to do further work until additional important problems arise.

*Association of American Railroads*

*Committee on Fusion Welded Tank Car Tanks*

There have been no meetings to which your representative was invited to attend. It is recommended that A.W.S. representation be continued.

*American Society for Metals*

*Metals Handbook Committee*

The representation of the AMERICAN WELDING SOCIETY on this Committee has continued throughout the year. There was one meeting of the main Committee. Subcommittees have been organized and work is in progress in revising and improving the next edition of the *Metals Handbook*. The revised articles are being examined as received. Progress in this activity can be reported. Recommendation is made that representation of the AMERICAN WELDING SOCIETY on this Committee be continued.

*American Petroleum Institute*

*Field Welding of Casing*

During the past year, no meeting of this Committee was held. There has been no activity of any kind during the past year on the field welding of casing.

*International Acetylene Association*

*Committee on Welding and Cutting Chapters of A.S.M. Metals Handbook*

This Committee has been inactive during the last year because no action has been taken to revise the *Metals Handbook*.

# YOUR OPERATORS, TOO

## WILL FIND IT EASIER TO MEET SPECIFICATIONS WITH THESE

# PRODUCTION-PROVED ELECTRODES

Copyright, 1944,
General Electric Company

GE

## ARC-WELDING ELECTRODES

Excellent welding characteristics are assured because each G-E electrode is specifically designed to meet all the requirements of the one A.W.S. classification under which it is listed. No attempt has been made to make any one electrode meet more than one classification, as this invariably requires a sacrifice in performance.

● Once the proper welding procedure is established, the operator can follow it with confidence, knowing that the electrode characteristics will not change. This uniformity of G-E electrode production is maintained by accurately controlled manufacturing and testing procedures.

### *More Reasons Why the Trend is to G-E Electrodes*

● Production data, printed right on the carton, make it easy to estimate weld-footage per pound for typical joints.

● Each electrode is production-proved in G-E factories and is establishing an outstanding performance record in thousands of shops all over the country.

● The complete engineering and research facilities of the General Electric welding laboratory, and a nation-wide organization of top-ranking welding distributors, are available to every user of G-E electrodes.

● For detailed information and samples of General Electric production-labled arc welding electrodes, and for data on G-E arc welders and welding accessories, simply contact your G-E arc welding distributor or the nearest G-E office, or write to General Electric, Schenectady 5, N. Y.

Buy all the Bonds you can—and *keep all you buy*